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Perspectives on Mobility and Choice

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The Cover:

With due apologies to Lewis Carroll, the White Rabbit on the cover and throughout, is meant to convey the need for haste in the amount and quality of urban transportation planning. The authors hope that those policy- and transportation-planners reading this report will not be forced to say, as was the White Rabbit, "Oh dear, oh dear I shall be too late!"

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This report was compiled and written by the authors listed above, each of whom was a participant in the 1974 NASA-ASEE Summer Faculty Fellowship Program in Engineering Systems Design. The authors represented nineteen different colleges and universities, and thirteen different academic disciplines.

URBAN TRANSPORTATION:
Perspectives on
Mobility and Choice

Editors: **Michael Z. Sincoff**
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Curtis M. Brooks

1974 SUMMER
FACULTY FELLOWSHIP PROGRAM IN ENGINEERING SYSTEMS
DESIGN

NASA-LANGLEY RESEARCH CENTER
AMERICAN SOCIETY FOR ENGINEERING EDUCATION
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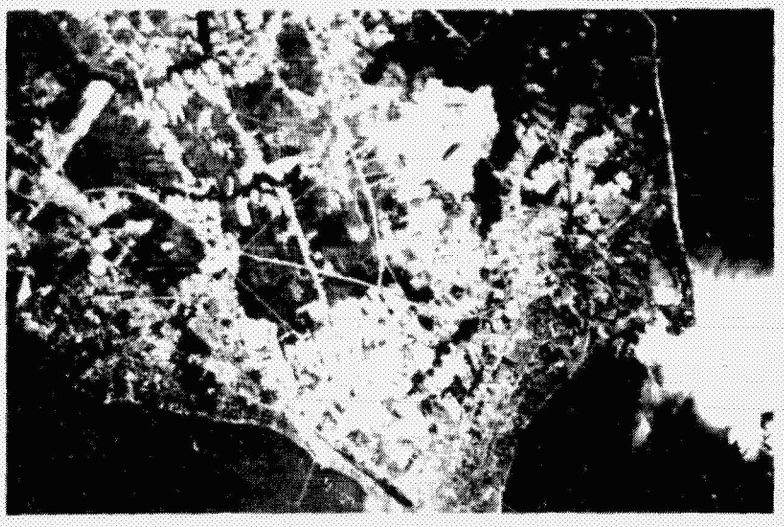

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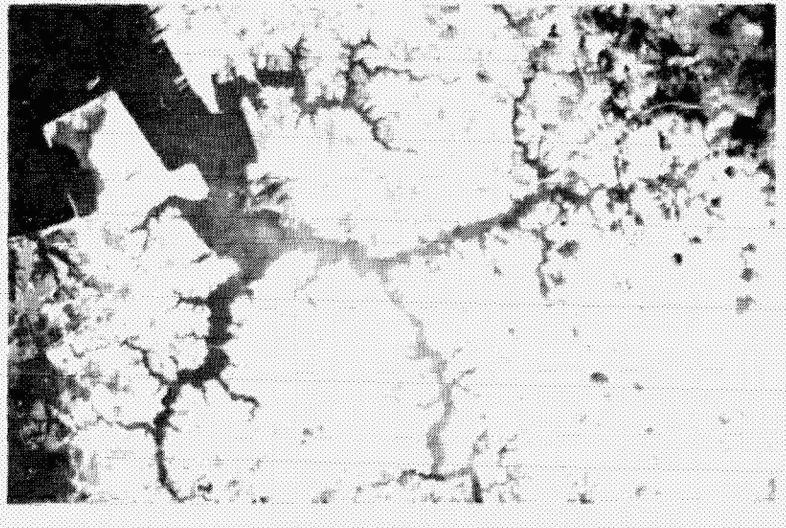

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FOREWORD

This document summarizes the results of the 1974 NASA-ASEE Summer Faculty Program in Engineering Systems Design conducted at the NASA-Langley Research Center in Hampton, Virginia during the period June 3 through August 16. The program was sponsored jointly by the National Aeronautics and Space Administration and the American Society for Engineering Education through a contract by NASA (NGT 47-003-028) to the Old Dominion University Research Foundation of Old Dominion University.

Included among the objectives of this program were to: (1) provide a framework for communication and collaboration between academic personnel, research engineers, and scientists in governmental agencies and private industry; (2) provide a useful study of a broadly based societal problem requiring the coordinated efforts of a multidisciplinary team; and, (3) generate participant experience in, and foster interest toward, the development of systems design activities and multidisciplinary programs at the participants' home institutions.

These three objectives were met through a study of urban transportation systems, characterized by intensive scrutiny of many ideas, philosophies, and academic perspectives on this multidimensional problem. To assure awareness and testing of many points of view, and to achieve some convergence of the best ideas, a group of 20 investigators was assembled. The design team represented 19 different colleges and universities, and 13 academic disciplines—aerospace sciences, civil engineering, economics, electrical engineering, English literature, environmental engineering, hydrology, law, mechanical engineering, organizational communication, political science, psychology, and sociology. (See Appendix A.)

The report resulting from this multidisciplinary effort is intended to communicate some dimensions of the urban transportation problem to the general public, to governmental bodies, to transportation policy makers, and to private industry. Toward achievement of that goal, the efforts were made to: (1) determine some of the major relationships between transportation and urban change; (2) identify problems caused, or contributed to, by the transportation system; (3) propose possible solutions or methods of alleviation for these problems; (4) explore the issues of multidisciplinary and multiagency transportation planning and decision-making; and, (5) use the Tidewater, Virginia area as a general model illustrating issues, problems, and possible solutions to the above.

Although the presence of a multidisciplinary team has been essential to the success of this study, the program itself has been enhanced by guest lecturers and consultants (see Appendixes B and C). Additionally, particular appreciation is expressed for the administrative support provided by the Co-Directors of the NASA-ASEE Summer Institutes, Dr. John E. Duberg of NASA-Langley, and Dr. G.L. Goglia of Old Dominion University. The assistance of Mr. John Witherspoon and Mr. Pat Clark, both of the NASA-Langley Personnel Training and Educational Services Branch, Personnel Division, was indispensable to the functioning of the program.

Mr. D. William Conner and Mr. Bobby G. Batten of NASA-Langley served as technical advisors to the Design Team from its inception to its conclusion. For their assistance, the participants express appreciation.

Michael Z. Sincoff, Project Director
Jarir S. Dajani, Assistant Director

August 16, 1974

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PLANNING FOR URBAN CHANGE

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Chapter I

PLANNING FOR URBAN CHANGE

I. The Pressure of Change

The history of human settlements is a history of two dynamically interacting orders of change: technological and sociocultural. Technological change refers to transformations of the natural environment brought about through man's use of tools and techniques. Sociocultural change designates alterations in the styles, forms, and modes of cultural, political, and social organization. The interaction between these two orders of change was succinctly described by Marshall McLuhan: "We shape our tools and our tools shape us."

This report deals with the phenomenon of change as it occurs in urban areas generally, and in the transportation sector specifically. Within these areas, the concept of change as it is manifested in both technological and sociocultural conditions forms the theme on which this study is centered. The control of change is the basis of planning, and the conclusions and recommendations presented here are intended to assist the transportation planner and urban decision-maker in this task. Chapter I summarizes these concepts with particular emphasis on placing the concept of transportation change in an historical and urban context. Chapter II presents change in terms of evolving technological choices for transportation both present and future. The theme is continued in Chapter III, in which the social and psychological effects of transportation-related changes are analyzed. Chapter IV deals with the effects of institutional changes upon the transportation sector and provides a detailed picture of such relationships in the Tidewater area. Last, the conclusions and policy options arising from these differing aspects of change in urban transportation are summarized in Chapter V.

It is now commonplace that technologies—nuclear power, telecommunications, computers—alter institutions and individual values, that they create problems and opportunities for man's economic and political organizations. New technologies have shaped the course of history since the beginning of time. Technological change itself can be thought of as a set of measurable differences in the physical environment resulting from the application of some force. First the force was fire, then later, wind and water. Water and fire were brought together in the steam engine which in turn helped to shape industrial civilization. Industrial civilization was responsible for the most important new sociocultural invention: the invention of invention. The intervals between scientific discovery and technical development narrowed: 112 years elapsed between the discovery and application of photography; 56 years was the interval for the telephone; 35 years for the radio; 12 years for television; 10 years for the nuclear reactor, while transistor devices were marketed on a large scale only three years after the discovery of the transistor (18, p. 2).

If graphs were to be drawn showing the rates of technological change from historical times to the present of such dimensions as the velocity in human transportation, the annual extraction of metals from the Earth, or the yearly consumption of energy, the curves in every case would show almost identical shapes. With time measured along the horizontal axis and rate of change along the vertical, the curves would begin in the ancient Near East with a very flat slope, then rise more and more sharply through the periods of the Renaissance and Industrial Revolution, until, in the present era, they would be rising almost vertically.

Sociocultural change is not measurable as directly as technological change. Yet, at any given time in history, the sociocultural order determines the uses of available technology. Humanists are accustomed to classifying western history into various periods or epochs and to treating each as a homogeneous cultural pattern: the Renaissance, the Reformation, and so on. Each epoch is characterized by a particular world view and a particular set of ideas concerning the nature of man. Although sociocultural change within a particular period is a continuous process, there are transitional periods between cultural epochs which often are marked by crisis. Changes from one image of man to another always involve value conflicts: the old resisting the new. These conflicts find direction and eventual resolution when changing images precede technological change. When images lag behind sociocultural development because of inertia or institutional rigidity, periods of social crisis and, possibly, chaos arise.

The process of sociocultural change can be viewed functionally as the relationship between two curves, one being the image of man and the other his actual sociocultural development, as shown in Figure 1-1. The curves move through time tracing out various cultural epochs, developmental plateaus, and the inter-

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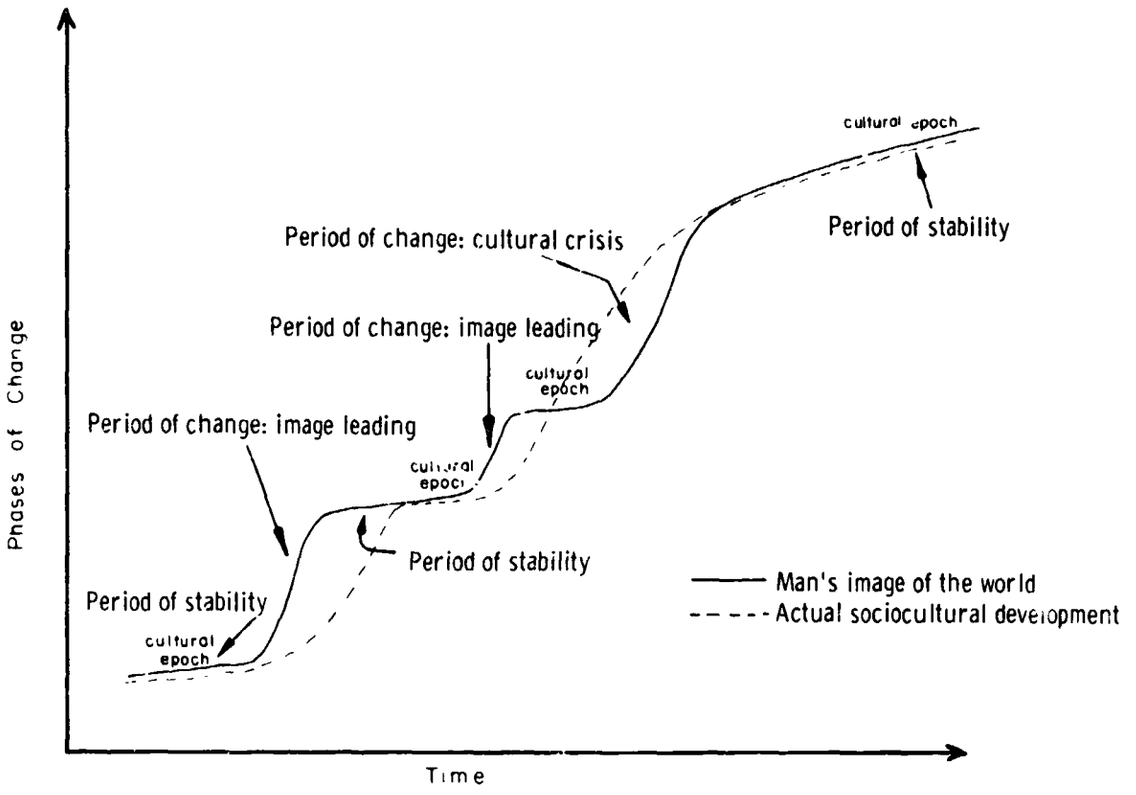

FIGURE 1-1
INTERACTION BETWEEN CULTURAL IMAGES AND SOCIOCULTURAL DEVELOPMENT

vening transitional periods. When the operational image of man is consonant with his sociocultural development, the existence of parallel, overlapping plots marks out periods of stability. In period of change, during which the evolving image gives strong direction to the forces shaping the institutions, the plot of image leads that of sociocultural development. Conversely, in periods of change during which the image of man weakens or lags behind the developmental forces a crisis of cultural direction results.

An image is basically the set of assumptions held by society about man's origin, nature, abilities, characteristics, relationships with others, and place in the universe (31, p. 1) For any given epoch, the image is the root of all value choices, as well as the dynamic, organizing, and controlling metaphor which gives meaning to all modes of human action and experience. For example, if man sees himself as separate from or superior to nature, then an ethic of exploitation can be fostered more easily. If he thinks of human beings as solely or predominately spiritual beings, then he is likely to ignore the purely material aspects of existence, such as public health, employment opportunities, and housing

In the Middle Ages, the prevailing image was that of man carrying out a specific function in a hierarchy of nature, beginning with a chain of being descending from God, down through the orders of angels, to man, the lower animals, the plants, minerals, and so on. This image assisted in the organization of society along lines analogous to the organization of the universe. The king functioned as ruler of society, while the peasants had their complementary place and function. Even animals were categorized in this maner: the lion was "king of the beasts;" other animals belonged to lower orders; the worms and slugs were the lowest in

the scale. Overall, this powerful medieval image assisted in the smooth functioning of both royal and ecclesiastical power structures and provided a place for every person in the social order. However, the consequences of this image were that little social mobility or progress was possible or, indeed, desirable.

By contrast, in the period of industrial growth characteristic of the eighteenth and nineteenth centuries, the emergent idea of nature as essentially competitive rather than cooperative resulted in, and in turn was influenced by, the formation of a new controlling image based upon capitalistic and social forms of competition.

Indications are that the present period of human history is nearing its completion and that the world is in transition to a very different epoch. The accelerating processes of change cannot continue indefinitely into the future: exponential curves grow to infinity only in mathematics. Man may be reaching what has been called "plateaus in science and technology" (23).

The present transition may be described as a change from an image of man based upon an "Industrial State" paradigm to one based upon an emerging "Post-Industrial State" paradigm, whose outlines as yet are only dimly perceived. Part of this emerging paradigm involves the idea of "holism," or the belief that the whole cannot be reduced to the simple sum of its parts. On a global scale, the interrelatedness of the technological and sociocultural orders is so close that planning must involve not only technological components but also considerations of the whole system--including the value systems on which choices are made. In describing the complexity of this task, Max Ways stated that the main problems

> turn not around the production of goods, but around the difficulties and opportunities involved in a world of accelerating change and ever-widening choices. So swift is the acceleration that trying to "make sense of change" will come to be our basic industry. Aesthetic and ethical values will be evolving along with the choices to which they will be applied (28, pp. 1-3).

Multidisciplinary studies of the urban sphere reveal this interrelatedness of value and technology extremely well. On the basis of such considerations in the transportation sector, a number of general lessons have emerged in recent years: (1) Transportation planning must be integrated with comprehensive urban planning. Urban planning should be directed towards making the functions of the city maximally accessible. (2) None of the three basic variables in the urban system—land use, transport systems, and human behavior—can be held constant. They are dynamically interrelated factors which can and must be used in planning as both independent variables (means) and dependent variables (ends). (3) The main planning problem is the identification of goals within the flux of elusive and shifting values. (4) Not surprisingly, the chief obstacles to the solution of transportation problems are to be found in institutional weaknesses rather than in any lack of technology.

Thus, in order to "make sense of change" in the transportation sector, it is necessary to look briefly at the history of urban functions and the dynamics of urban change. Historical perspective is an exceedingly practical means of obtaining an understanding of the present transition period through which mankind has begun a tortuous and by no means predictable journey.

*"A slow sort of country!" said the Queen. "Now, **here**, you see, it takes all the running **you** can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that."*

—Lewis Carroll

II. The City

What is a City?

There is no scientific definition of a city; a city is many things to many people. The word is assigned in ad hoc fashion to very diverse kinds of settlements. It is commonly used as a broad generic term for an urban area, consisting of "large" settlements of people in "small" amounts of space. Used in this sense, it is differentiated from a rural area, where there are "small" settlements in a "great" amount of space. Jane Jacobs has written that

> Perhaps the best Analogy (to a city) is to imagine a field in a darkness. In the field, many fires are burning. They are of many sizes, some great, others small; some far apart, others dotted close together; some are brightening, some are slowly going

> out. Each fire, large or small, extends its radiance into the surrounding murk, and thus carves out a space...the murk has no shape or pattern except when it is carved into space by light (13, pp. 376-377).

Metaphorically, the city has been considered as an extended family, an organism, and a microcosm. There are nearly as many definitions of city as there are people. As with Humpty Dumpty, the word city "means just what I choose it to mean—neither more nor less" (1, p. 269).

Perhaps thinking of the city as a **thing** is part of the definitional problem. In ancient, concentric cities, the wall gave the city a definite spatial identity; there was a distinct inside and outside. Later when the walls disappeared as a result of armed invasion or of increased population, the "wall" became more institutional (in terms of specific legal limits) than physical. Oswald Spengler wrote that cities have "souls," that they go through periods, as do civilizations and men, of infancy, adolescence, adulthood, senescence, and death (26).

The city is often personified, as in "Chicago, hustling, brawling, city of the big shoulders" (24). Primitive peoples would often keep the name of their villages a secret, because they believed that the essence of the village, its destiny, was contained in its name and that enemies could destroy it if they knew its name. Perhaps Constantinos Dioxiadis is closer to the real nature of a city when he thinks of it as a "field of force" in which energy transactions take place through the mediation of five basic organic systems: man, society, shells (systems of shelters), networks (the systems through which the interactions between the other systems take place), and ekistics (the science of human settlements) (5).

An etymology of "city" might begin with the Latin *civitas* which was an association of families and tribes unified by common religious and political beliefs. The *civitas* was an institution, an organization, not a place. The sanctuary, the place of association, was called *urbs* from which many well known descriptive terms derive. City and urban are often used synonomously. The Greek *polis*, translated to city, is the root of numerous contemporary words pertaining in some way to human settlements—metropolis (figuratively city, but literally "mother city"), megalopolis (super city), and from Doxiadis, ecumenopolis (world city).

For many purposes it is useful to consider a metropolitan area as divided into two parts: the city (or central city) and the suburbs. The United States Bureau of the Census, in 1969, adopted the term Standard Metropolitan Statistical Area (SMSA) to mean a county or group of contiguous counties with one city or twin cities having a combined population of at least 50,000 inhabitants. Census data for SMSA's are divided into the "core" and the "ring." Thus, the Philadelphia SMSA, for example, consists of the core area of Philadelphia and a ring of seven contiguous counties which are socially and economically bound to the city.

Historical Perspectives

Beyond the statistical definition, however, a city is fundamentally a cultural container whose unique office is to "increase the variety, the velocity, the extent and the continuity of human intercourse" (21, p. 451). Technological and sociocultural evolution and devolution are most visible in the city, which is the locus of the fundamental changes and transformations of man. Man shaped his cities, to paraphrase McLuhan, and his cities shaped him. Table I-I outlines the changing roles of cultural images and city functions that have shaped Western civilization over time.

From the standpoint of evolution, the city, like other social and biological organisms, possesses what have been called emergent characteristics—that is the whole displays characteristics and embodies functions and properties which could not have been predicted from the characteristics, functions, and properties of its parts. No mere extension of the village could produce the city. The integration of highly specialized units, the close proximity of diverse elements, and the concentration of population all combined to transform the traditional modes of human association that were present in village life. New forms of group life developed, as well as new values, new perspectives, and new ways of thinking and feeling. The **principal function of the city,** then, is the evolutionary transformation of man and his institutions: the city is the chief instrument of man's self-actualization and fulfillment.

Man is a schizoid being, and his needs are quite often contradictory: security and adventure, rest and motion, permanence and change. The early paleolithic hunters were constantly on the move in search of food, but they regularly returned to sacred burial grounds and caves to rest, to gather strength, and perhaps to enlist the aid of the spirits of the ancestral dead in future hunts. The "place" of such gatherings

	Image of Man	City Functions	Transportation/Communication
ANCIENT NEAR EAST (ca 3000BC to 600 BC)	Man as servant of the gods Each human ambition translated into a divine image.	Concentric city: Sumerian ziggurat or "world mountain" housed the urban gods, every citizen equidistant from source of spiritual, social, and economic order.	Single-directed: from the house to the temenos (sacred precinct); from the city to open land; from man to idol.
CLASSICAL (600 BC to 100 BC)	Man as free citizen of the polis Man is a political animal	City as aesthetic and political image: community affairs are the affairs of all.	Centripetal. religion, art, games, the discussion of things, could be fully satisfied through the polis. Most values accessible in a single place; no need to change location.
ROMAN (100 BC to 400 A D)	Man as imperial conquerer.	Containers maintained by the spoils of empire stored within their walls. Assyrio-Hellenistic orthagonal pattern: embodiment of image of the conquering hero.	Imperial city involved in vast network of interests and communications. Growing specificity of urban functions; standardization of street widths, paving public works, fines, city limits. Different places within and without the city make travel necessary.
MEDIEVAL (400 AD to 1400 AD)	Man as central in divine hierarchy the Great Chain of Being	No cities; town as a nucleus and the surrounding villages to a distance of 10 to 20 miles; culturally homogeneous social units. Towns function as isolating and protective units in absence of overall political and social order.	Travel as an agrarian, biorhythmic function; travel to town nucleus on market and festive days; pilgrimages in the spring to shrines like Canterbury. Pace of communication and travel leisurely and contemplative.
RENAISSANCE (1400 AD to 1600 AD)	Man as microcosm The re-discovery of the individual and the intellective potential of man.	City as a materialization of Classical ideals; city as a storehouse and container of culture, past and present; gives spatio-temporal continuity and extension to human culture.	Travel as exploration and adventure and as a means of extending national powers; travel as metaphor for learning, breaking bounds. Communication: Printing Press. Reading becomes a way of traveling.
INDUSTRIAL REVOLUTION (1600 A D to 1950 AD)	Man the servant of industrial metaphors: the machine Man the master of nature	City as machine with specialized parts; increased regimentation, standardization needed for efficient organization and transmission of information and goods.	Creation of "travel to work"; cicadian traffic rhythms replace agrarian biorhythms. Specialized organization of space creates travel to work. Mobility and travel perceived in a context of values in which motion, progress, growth seen as good in themselves.
POST-INDUSTRIAL CIVILIZATION (1950 AD to ?)	Man as process. Transpersonal man. New Holism.	City as a syntropic (negative entropic) self-organizing system; optimal size and structure perceived as a function of man's self-actualization and maximum use of his constantly expanding potential	Trans-intellectual, energy efficient design for transportation systems, together with socio-technological restructuring of urban systems (political, social, economic) maximizes accessibility to opportunities and experiences in urban environment.

TABLE I-I
THE ROLES OF CULTURAL IMAGES

took on a special character, the character of the shrine. Paleolithic drawings, such as those in the Caverne des Trois Fréres at Ariége (20, p. 16), indicate man's early attempt to find a center, a spiritual home. To find such a place was to meet a spiritual need for a central focus, a center, and a meaning. The "place" became a primary symbol of value and meaning. In later cosomologies, it became the source from which all things originated (7, pp. 380ff.). Such a place eventually became the nucleus of the city—the source of power.

But physical needs also had to be met. For the hunters, such needs were met by traveling, while their spiritual needs were met by rest. About 15,000 years ago, the first definite indications of permanent settlements appeared from India to the Baltic Sea. At these places, physical needs could be met in a relative state of rest. The culture of these small settlements seems to have been based mainly on the use of shellfish, fish, seaweed, and tubers, although plant foods, such as the date palm, olive, fig, apple, and grape, were reproduced by cuttings. Three thousand years later, there was the appearance of the systematic planting of seeds and the domestication of animals—the ox, sheep, ass, and later, the horse (20, pp. 19-20). These neolithic agricultural villages, perhaps at first using shells as containers, developed a technology of containers—ceramic pottery, irrigation ditch, aqueduct, canal, reservoir, and sewer. Village life fostered the conservative virtues of conformity, repetition, and patience for thousands of years.

Then suddenly, about 3,000 B.C., there was an urban explosion—cities suddenly blossomed. One theory of Lewis Mumford is that cities arose from the union of the older, paleolithic (hunting) societies with the later neolithic (agricultural) cultures (20, pp 21-22) The master institution of kingship was the binding, unifying force (9, pp. 94ff). The chieftain of the hunting tribe embodied the kingly virtues of authority, keeness of mind, decisiveness in emergencies, adventuresomeness, and imagination. These dynamic paleolithic qualities carried over and dominated the later neolithic traits. Moreover, the chief, as spiritual leader of his tribe, also exhibited supernatural authority He quickly became identified as an all-powerful representative of a cosmic deity. In later times, the functions of king and priest (or priestly caste) were separated, although the earliest existing traditions of the Sumerians claim that their cities were built by a god, or by the gods.

With this kingly organization, the city became a center of control. The surplus of manpower, provided by the stable, life-oriented, neolithic culture, was deployed for public works and military exploits on an unprecedented scale. The king ruled from the place, the center, which became the walled citadel: a nucleus within the city containing the temple, the palace, and the granary. It housed the ruling group and protected them from attack by the inhabitants of the city (21, p 449). The many diverse elements of community life which previously had been scattered were not packed together. The pace of life was stepped up. The calendar, writing, exact astronomical observation, abstract mathematics, the sailboat, the plough, the potter's wheel, the draw loom and copper metallurgy—all sprang into use about 3,000 B.C. in the urban environment.

Despite these advances, there were drawbacks to this new kind of human organization. The increase in the interdependence of functions and the security and benefits accrued from them caused anxiety within the cities over their possible loss. In order to gain control over natural forces and over fate, human sacrifices were offered to the gods. The combination of the need for sacrificial victims, increasing dependence upon outside supplies and supply routes, and the desire for increased social control gave rise to the negative economic activity of war (20, p. 55). Almost every function of the city is double-edged, as each will have its positive and negative aspects

A city can be thought of as having the characteristic forms of the container and the magnet, both of which were present almost from the beginning (21, p 450). The first form, which was dominant until the seventeenth century A.D., consisted of a heavily walled inner nucleus, or citadel, of imposing, massive buildings surrounded by residences, workshops, markets and minor shrines, webbed with alleys and streets. The whole area was then enclosed with another massive wall, or perhaps several walls, and was entered through huge, heavy gates. The other form, the magnet, was characteristic of Egyptian cities in the pyramid age and also of the Acropolis cities of the Aegean In this open form, the authority of priests gave control and protection and was centered in the *temenos*, or sacred precinct The population was distributed in neighboring villages, country estates, and suburbs

In both of these urban forms, the village persisted as the componential unit. In the early stages of the city, each village unit might be self-contained to a large extent In Assur, there

were thrity-four temples and chapels, each with its attached village community. Every citizen in this community belonged to the temple and performed work for the particular god. Since in Assur, as in the later medieval spatial organization of households, guilds, and clans, the place of residence and the place of work were not differentiated, there was little need for travel.

Modern Elements

The forces that created the modern city were the forces commonly called "industrialization." First in agriculture, later in industry, there was an economic metamorphosis—a change from a household or guild economy to a rationalized, capitalistic economy. Innovation, beginning in the late eighteenth and early nineteenth centuries, created a growing capacity to produce far beyond the local demand. Previously, markets had been very much like the village fair, in that they depended very much on the chance contact of buyers and sellers. After the eighteenth century, increasing productivity created a need to predict markets precisely, since success required a favorable balance between production cost and selling price. The additional administrative problems created by heavy capital investments demanded some mechanism for the speedy organization and transmission of both information and goods. A new regimentation and ordering emerged in the city to supply this needed mechanism.

This new order involved a new and more differentiated pattern of spatial utilization in the city. In the older pattern, based on the symbolism of the center, such monumental structures as churches and palaces occupied central places. In the new order, space was allocated on the basis of its most profitable (efficient) use: buildings and areas of the city were set aside for the special uses of trade, industry, or residence. Instead of one center, the city became pockmarked with multiple centers. The new pattern involved the separation of work space and living space, creating the need to travel to work.

Shortly after 1820, there was a remarkable burst of innovation which peaked between 1875 and 1925. Within this period, urban populations grew spectacularly Travel to work was initially on foot, then, because of increasing cost-consciousness and increasing distances to be traveled, speed became important (14, p. 12). Widened streets became congested with wheeled vehicles, at first horse drawn, but later motor propelled.

The last remnants of the leisurely biorhythms of the neolithic, agrarian village were displaced by the need for rigid control of the use of time. The cicadian rhythms of morning, noon, and afternoon traffic became more insistent and more precise. Man had become tied to his work and propelled into the cyclical flows of movement necessary to reach it by the all-powerful hands of the clock.

Current Imperatives

Men, according to Aristotle, came together in cities in order to live and remained there to enjoy the good life. Today, men come to the city to work and then leave as often and as quickly as possible. Lewis Mumford observed the city as an accumulation of people accommodating themselves to

> an environment without adequate natural or cultural resources; people who do without pure air, who do without sound sleep, who do without a cheerful garden or playing space who do without the very sight of the sky and the sunlight, who do without free motion, spontaneous play, or a robust sexual life (8, p. 35).

Cities are commonly referred as sick, dying, decaying, or in crisis; one seldom hears of "robust cities." [1] If this is so, why do people gather and stay in cities?

The city and its inhabitants interact: problems arise, solutions are tried, and new problems are created. In a sense, the city is a constantly evolving Rube Goldberg machine in which parts atrophy, are destroyed, replaced or added as needed. Wilfred Owen spoke of the "accidental" city, but other observers have been much harsher in their indictments. George Bernard Shaw in 1903 referred to his home city in the following words: "The imagination cannot conceive a viler criminal than he who should build another London like the present one, nor a greater benefactor than he who should destroy it" (2, p. 100).

Urbanization is a complex process, but present day urban sprawl is a phenomenon strikingly expressed in statistics. In 1920, roughly one-half of the population of the United States was urban. Fifty years later, this proportion had risen to three-quarters of the total, as shown in Table I-II The reasons for this shift

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[1] See Mitchell Gordon, *Sick Cities* (12), where the metaphor of disease is most commonly expressed Some chapter headings will convey the perspective, as follows "Fire!" "Water Filthier and Farther, "Help Police!" "No Place for Fun," "Traffic Jam The Concrete Spread

TABLE I-II

Urban and Rural Population of the Coterminous United States, 1790-1970 (population figures in millions)*

Year	Total Population	Urban Population		Rural Population	
1790	3.9	0.2	5.1%	3.7	94.9%
1800	5.3	0.3	6.1	5.0	93.9
1810	7.2	0.5	7.3	6.7	92.7
1820	9.6	0.7	7.2	8.9	92.8
1830	12.9	1.1	8.8	11.7	91.2
1840	17.1	1.8	10.8	15.2	89.2
1850	23.2	3.5	15.3	19.6	84.7
1860	31.4	6.2	19.8	25.2	80.2
1870	38.6	9.9	25.7	28.7	74.3
1880	50.2	14.1	28.2	36.0	71.8
1890	62.9	22.1	35.1	40.8	64.9
1900	76.0	30.2	39.7	45.8	60.3
1910	92.0	42.0	45.7	50.0	54.3
1920	105.7	54.2	51.2	51.6	48.8
1930	122.8	69.0	56.2	53.8	43.5
1940	131.7	74.4	56.5	57.2	43.5
1950	150.7	89.7	59.6	60.9	40.4
1960	178.5	122.5	63.1	65.9	36.9
1970	203.2	149.3	75.5	53.9	26.5

* Based on new urban place definition; not comparable with earlier data.

Source: (19, p. 24).

TABLE I-III

Rate of Population Growth in Central Cities, Metropolitan Rings, and Nonmetropolitan Areas of the United States

		RATE OF GROWTH DURING PRECEDING DECADE (PERCENT)		
		Standard Metropolitan Statistical Areas		
Date	Number of SMSA's *	Central Cities	Rings	Nonmetropolitan Areas
1910	71	35.3%	27.6%	15.0%
1920	94	26.7	22.4	8.1
1930	115	23.3	34.2	7.1
1940	125	5.1	13.8	6.2
1950	162	13.9	34.7	6.0
1960	212	10.7	48.6	7.1
1970	243	6.4	26.8	6.8

* Data for 1910 through 1950 refer to the areas that would have qualified as SMSA's at the given dates according to the 1950 definition, as estimated by Bogue. Data for 1960 and 1970 refer to SMSA's central cities, and rings as defined at those census dates. "Nonmetropolitan" comprises all areas outside SMSA's.

Source: (16, p. 31).

are partially administrative, in that some rural areas grew in size and were later re-classified as urban. However, the principal reasons for growth of urban areas has been the increased productivity of the agricultural sector, which has freed man from the soil and allowed him to pursue other livelihoods in cities, and the increased influence of the automobile, which has given man mobility to live away from his work place.

In recent years, the American City has been exhibiting **both growth** and **decentralization**. Development spreads ever outward, while at the same time the center, or core, loses population to the ring of suburbs, as shown in Table I-III. The ring also receives people from the rural areas, and so grows even more in both horizontal and vertical directions. While the suburban areas maintain a high rate of industrial and population growth, the central cities are losing jobs as well as people.

Urbanization in the less developed regions of the world is proceeding at an even more rapid pace. According to United Nations' forecasts, urban population is expected to increase almost tenfold in these regions over the period 1950 to 2000. Table I-IV shows that the proportion of population in the urban areas of the less-developed countries will increase from 16 percent in 1950 to 43 percent fifty years later, and that two out of every three urban dwellers will live in these countries by the year 2000. Figure 1-2 dramatically illustrates these likely population shifts. What the statistics do not show is the pain and misery that arise out of the conditions of poor health, inadequate housing, insufficient employment, and lack of opportunity found in many of these areas. In contrast to the American experience, many of these cities did not arise in response to agricultural surpluses and increased personal mobility. They often have neither the industrial base nor the impetus for modernization characteristic of Western cities. Having arisen as a primary consequence of political decisions, such cities in the developing world now find themselves in an especially precarious position with regard to feeding and housing their growing populations.

Cities exist because they serve functions which are means to a variety of ends. In the Western world cities evolved in response to, and were responsible for, industrialization. There was a symbiotic relationship between urbanization and industrialization: the former provided the setting, while the latter provided the impetus for change. This relationship had many facets and allowed industrial cities to serve a variety of functions, many of which remain relevant today.

In an economic sense, cities are more or less efficient organizations for the production of goods and services. As long as man values the efficient production of these things, cities will be essential. They will not necessarily die if

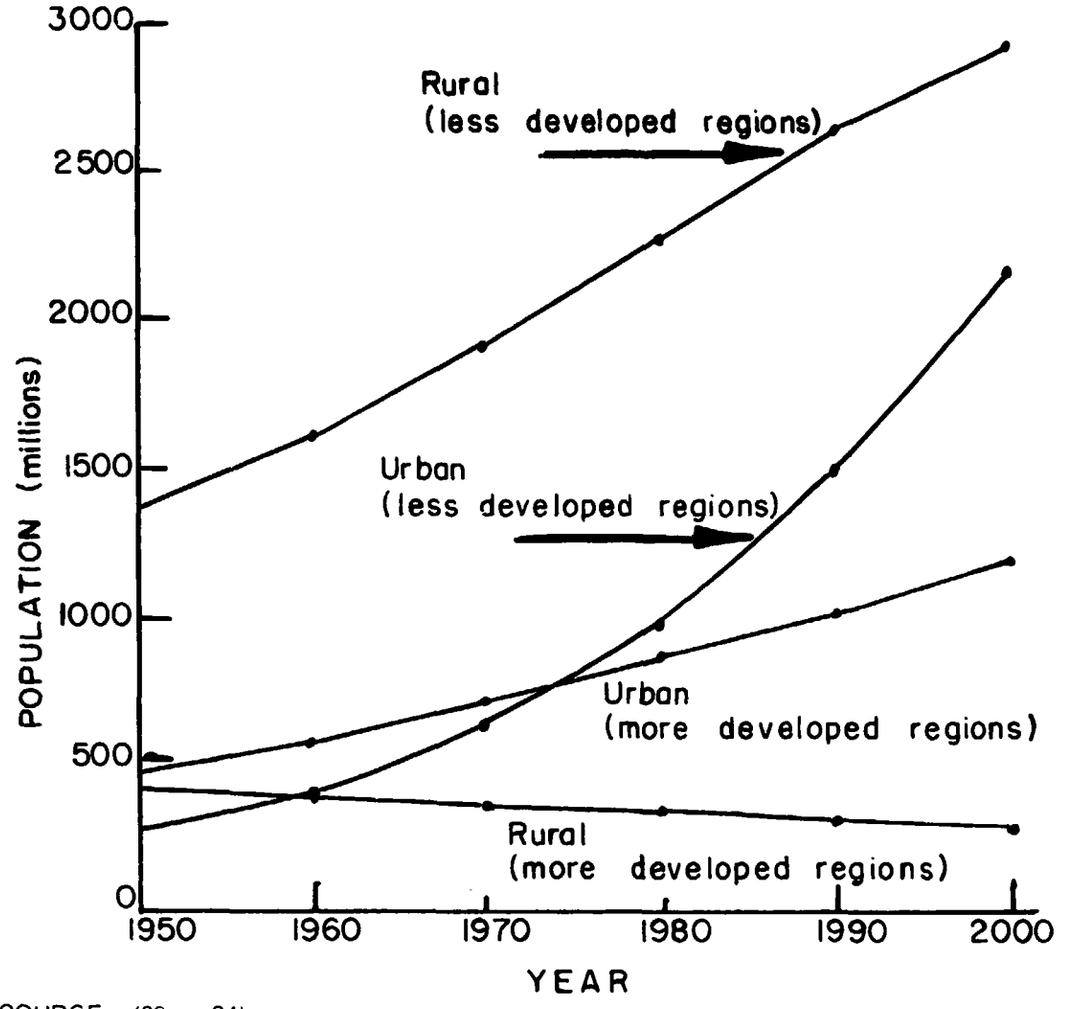
TABLE I-IV

Urban/Rural Population* and the Percentage of Urban Population, in More Developed and Less Developed Regions, 1950-2000

Year	More Developed Regions			Less Developed Regions		
	Population (millions)			Population (millions)		
	Urban	Rural	Percentage Urban	Urban	Rural	Percentage Urban
1950	439	418	51	265	1,363	16
1960	582	394	60	403	1,603	20
1970	717	374	66	635	1,910	25
1980	864	347	71	990	2,267	30
1990	1,021	316	76	1,496	2,623	36
2000	1,174	280	81	2,155	2,906	43

* The definitions for "urban" and "rural" are those in use in each country.

Source: (32, Chap. 1; 33, p. 24).



SOURCE: (33, p. 24).

FIGURE 1-2
URBAN AND RURAL POPULATION, IN MORE DEVELOPED AND LESS DEVELOPED REGIONS, 1950-2000

this value set is modified, for cities serve other functions as well. These functions transcend an economic imperative, but the economic arguments are the most developed and compelling ones.

Joseph Clark, a former United States Senator from Pennsylvania, has observed that "cities are our greatest source of economic strength. In many ways our national welfare is dependent upon their continued efficiency as instruments of production in our national economy" (8, p. 26). Clark was speaking of the external or outward serving functions of the city insofar as they respond to national needs. Thus, a city serves an internal function of producing for itself and an external function of producing for others. In addition, the city is parasitic as well and must be fed from without. Cities can exist only in areas which have access to food surpluses. Elsewhere man is bound to the soil and must produce food for his family. If agriculture becomes sufficiently productive to yield consistent surpluses above immediate family needs, some men may be freed from the land. Towns are born when these men gather to produce non-agricultural goods

in exchange for the food surplus. The process of urbanization, therefore, is linked to increases in agricultural productivity and the size of the resulting food surplus in the rural areas.

Thus, cities arose where agricultural surpluses allowed the establishment of large communities. Urban growth resulted in, and in turn was accelerated by, economies of agglomeration, which Heilbrun has described as

> ...the result partly of a kind of inverted pyramiding. One industry—say, shipping—locates at a place because it has a good natural harbor. That activity then attracts others linked to it—say, banking, insurance, inland transport. The concentration of those industries in turn attracts others linked to them—say, a stock market, a commodity exchange, a printing and publishing industry, a university. And, of course, all these build up a large demand for "local-market" products—that is, for the services of retail traders, bankers, dentists, plumbers, policemen, bus drivers, school teachers, and all other members of the "local-market" sector, who provide services both to those in the national sector and to other local-market producers (16, p. 13).

The economies from agglomeration accrue from spatial concentration of production. Edwin Mills has identified three kinds of agglomeration economies, the first and most important being a result of the law of large numbers. For most producers, sales and purchases are subject to seasonal, cyclical, secular, or random variation. Insofar as these variations are not correlated among producers, an urban area with many employers can provide more nearly full employment of its labor force than can an urban area with few employers. Similarly, a firm selling to many buyers can hold smaller inventories and have more nearly continuous production than can a firm with few buyers

A second economy is traceable to complementarity in the supply of labor and in production. According to Mills,

> Different kinds of labor are to some extent supplied in fixed proportions. Industries with large demands for female workers are attracted to areas where women live because of their husband's workplaces. Complementarity in production works the same way If two commodities can be produced more cheaply together than separately, then users of both commodities will be attracted to areas where they are produced (19, p. 17).

The third agglomeration economy was suggested by Jacobs, who argues that spatial concentration of people allows and forces a process of creative interaction, the outcome of which is new ideas, concepts, and processes (13). This interaction is a prime source for growth, innovation, and progress.

The city offers advantages as loci for economies of consumption in addition to those of production. Certain cultural amenities are available only in large communities—opera, symphonies, museums, and professional sports for example. The range of available consumer goods, in many cases, varies directly with community size. It can be argued that these amenities have value to the city dweller even if they are not chosen. The potential value of available, although unchosen, alternatives provides what can be termed option value to the urbanite (4)

In addition to the economic aspects, cities also serve other functions. Cities often are viewed as having personalities and distinct characteristics of their own. If a single dominant trait were selected for each of a large number of cities, a series of recurring functions could be identified. Ralph Thomlinson observed that these functions include economic political, religious, educational, entertainment, health, and residential traits, and Table I-V shows his attempt to classify a variety of cities from around the world within these categories

To a greater or lesser extent, most cities perform all of the functions shown in Table I-V. One very important function not reflected in the table, however, is that cities provide a way of life distinctly different from that found in nonurban areas This life style is not always definable, but it can be contrasted with that of the rural areas. Life in major cities is filled with opportunities, and the menu of activity is almost boundless. Things happen in the cities, the pace is frenetic, life is fast, and a wrist watch is almost indispensable The city offers freedom to be anonymous and alone, to choose from many life styles, to change jobs without moving, and to interact socially Within broadly defined constraints, one can become whatever one wants in the city.

To serve its external functions well, the city also must serve several internal functions It must provide jobs, housing, transportation, and

TABLE I-V
Dominant Functions of Selected Cities

I. Economic
  A. Extractive
    1. Fishing (Gloucester, Mass.)
    2. Mining (Butte, Mont.)
    3. Oil (Tulsa)
    4. Farming (numerous small towns)
  B. Manufacturing
    1. Large-scale industry (Bethlehem, Pa.)
    2. Medium-scale industry (Milwaukee)
    3. Small industry (New Bedford, Mass.)
  C. Trade
    1. World (New York, London, Tokyo, Amsterdam)
    2. National (Brussels, Stockholm)
    3. Regional (Chicago, Caen, Liverpool)
    4. Local (most small towns)
  D. Transportation
    1. Ports (San Francisco, Marseilles, Southampton, Bremen)
    2. Inland cities (St. Louis, Kansas City)
    3. Vehicle manufacture (Detroit, Wolfsburg, Coventry)
  E. Service
    1. Financial (Salt Lake City)
    2. Insurance (Hartford)
    3. Advertising (New York)
    4. Storage and distribution (most cities)

II. Political
  A. Civil
    1. World (New York, Geneva, London, Paris)
    2. National (Washington, Moscow, Ottawa, Canberra)
    3. Regional (Chicago, Toronto, Quebec)
    4. Local (Jefferson City, Mo.; Augusta, Me.)
  B. Military
    1. Fortresses (Gibraltar, Singapore)
    2. Bases and training centers (Brest, Toulon, San Diego, Norfolk)

III. Religious
  A. Authority and leadership (Salt Lake City, all bishoprics)
  B. Pilgrimage (Lourdes, Mecca, Benares)
  C. Symbols (Jerusalem, Bethlehem)

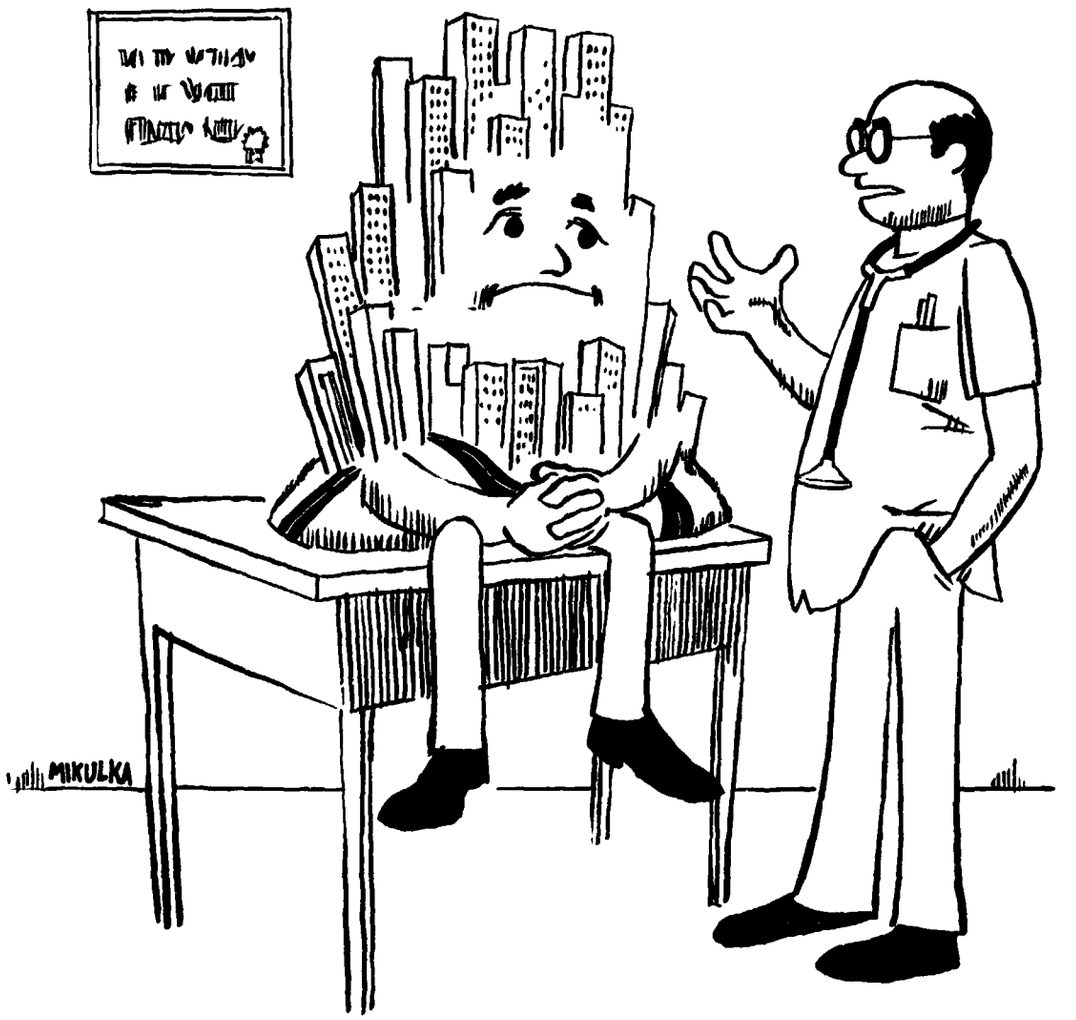
IV. Educational
  A. Higher learning or research (Oxford, Princeton, Ann Arbor, Amherst)
  B. Communications media (London, Tokyo, New York, Los Angeles)
  C. Museums (Rome, Florence)
  D. Historic shrines (Stratford-on-Avon, Athens, Boston, Philadelphia)

V. Entertainment
  A. Summer recreation (Nice, Monte Carlo)
  B. Winter recreation (Colorado Springs, Sun Valley)
  C. Showplaces (Venice, Williamsburg, Virginia City)

VI. Health
  A. Medical care (Rochester, Minn.)
  B. Convalescence resorts (Vichy, Atlantic City)

VII. Residential
  A. Dormitory suburbs (Scarsdale, N.Y.; Montclair, N.J.; Beverly Hills, Calif.)
  B. Retirement cities (St. Petersburg, Fla; a number of California and Arizona towns)

Source: (27, pp. 67-68).



"YOU SEEM TO BE SUFFERING FROM GROWTH PAINS AND ARTERIAL SCLEROSIS..."

other life support services. The problems of the cities generally are described in terms of the inadequate manner in which these functions are performed. The contrasts appear endless: luxurious dwellings and turgid slums, lucrative employment opportunities with high rates of unemployment, sophisticated transportation technology but immobile urbanites, impressive medical facilities yet poor health care delivery. Examples of what is right and what is wrong with contemporary civilization are invariably drawn from the urban environment. The modern city truly reflects man's collective pride and collective prejudice.

Future Trends

Predicting the future is always a hazardous undertaking. Since the prediction cannot be verified ahead of time, the motives of the analyst become of prime importance to all who find any disagreement with the assessment. For such an audience, these motives, at best, are suspect and, at worst, are based upon outright advocacy of a special cause. In order to minimize the inevitable disagreements over the future assessment presented here, the assumptions upon which it is made and the purposes for which it is intended will be presented.

A basic proposition is that American cities

are in a state of extreme flux. Rapid change in function, physical characteristics, and social structure are causing severe stresses on both the systems maintaining the cities and the people utilizing the cities. As yet, there is little understanding of the causes and interrelationships of these stresses and even less understanding of practical policies for dealing with them. Apparently, urban order is declining and urban disorder is ascending. Very little effective action is being taken to reverse this trend.

If the present tendency for disorder continues unabated, a variety of situations will arise. Some of them already are clearly evident; others are beginning to appear only now. Given the uncertainties of the nuclear age, it is unrealistic even to attempt to view the future beyond the end of the present century. Nevertheless, the quarter century remaining provides ample time for successive generations of technological innovation, social thought, and political leadership to arise, flourish, and subsequently be superceded. Therefore, the prediction made herein, will be limited to the period 1975-2000. **Furthermore, it will be based primarily on an informal extrapolation of present trends** This extrapolation makes no provision for non-evolutionary changes due to enlightened leadership or widespread shifts in public attitudes. The essential **purpose of this prediction** is to show the likely future consequences of the existing urban situation and then *leave to the reader a decision whether this, or some other, outcome is desirable.*

The functions of a city, or more properly an urban area, can be viewed in terms of four major categories: employment, residential, sociocultural, and supporting services. **Employment** includes all available income earning opportunities; **residential** refers to the existence and availability of housing; **sociocultural** includes age, race, and income characteristics, as well as the opportunities for education, entertainment, and community service; and, **supporting services** includes shopping, transportation, water supply, police and fire protection, and so on. In addition, an urban area also may be classified in terms of geographic zones. Three such areas will be used in this discussion: (1) a central business district (CBD), where the commercial, financial, industrial, and entertainment aspects of a city are concentrated; (2) the city proper, consisting of the larger urban area surrounding the CBD and under the same governmental jurisdiction; and, (3) the suburbs, all independently-governed urban areas closely associated with the city but situated outside the city boundaries.

In an analysis of urban trends, both city functions and geographical areas are interrelated. Changes occurring in one dimension are reflected to some degree in all other dimensions. In the following discussion of future trends, neither priority of importance nor of causality is intended. Each characteristic is part of the whole.

Employment—Given present trends, the availability of employment opportunities in the CBD's will continue to decrease over the coming years as a result of city centers losing their former preeminence as the focus of overall commercial, industrial, and cultural life to widely scattered specialized centers on the city periphery and in the suburbs. With the decline of activity in the CBD, large employers, such as corporate offices and major retail stores, gradually will be replaced by smaller employers dealing with service outlets and specialty shops.

In the city proper, wage earners will be affected by the decline in the CBD to the extent that they are unable to follow the movement of their former employer or to shift to another employer. A pronounced shift to the suburbs of the more progressive and profitable industrial and commercial firms is likely to occur, causing remaining jobs in the city to be concentrated in firms that are marginally profitable or even in the process of going out of business The overall result will be a work force that is characterized by few skills, low income, high unemployment, poor job security and opportunity, and mostly non-white.

Employment opportunities will continue to expand in the suburbs, which will become increasingly dominated by huge shopping centers and large industrial parks. Firms from the CBD and city proper will relocate in these suburban areas With very few exceptions, new firms requiring highly skilled employees will be established only in the suburbs. The education and income level of workers in the suburbs will be considerably higher than those in the cities Severe unemployment problems, however, are likely to occur in those suburban areas where industries become both obsolete and non-competitive because of rapidly changing technology

Residential—Residential areas on the immediate periphery of the CBD will suffer continued physical decay as employment opportunities decrease in the CBD and as the middle and upper class residents move to the suburbs. The increasing poverty of these peripheral residential areas will cause the CBD to be encir-

cled by slum areas populated primarily by unemployed blacks, other minority groups, and white migrants from depressed rural areas. Because of racial clustering, high crime rates, and increased concern for personal security, there will be a growing avoidance of the city center by people living in the outlying areas The deteriorating environment surrounding the CBD will slowly spread outward, progressively engulfing additional residential areas of the city. The process will be accompanied by decreasing property values and increasing crime and unemployment rates. Local efforts to prevent community decay will be ineffective, and city hall-sponsored programs will prove to be too little too late. As a result, further migrations of middle class residents to the suburbs will occur. For the most part, these will be whites, but increasing numbers of black middle class residents also will depart. Severe social strains, primarily racial, will occur in the city neighborhoods between the remaining former residents and the newly arrived residents. There will be a great shift in zoning regulations causing the former single-family residences to become multi-family tenements.
will be a great shift in zoning regulations causing the former single-family residences to become multi-family tenements

In the suburbs, vast new tracts of housing will arise almost overnight, causing a boom in agricultural land values. Racial segregation will become well established with the formation of all-white or all-black suburbs. In addition, there will be an increasing tendency for residential segregation on the basis of income. More suburbs will be established, zoned, and administered only for the purposes of accommodating a particular class of people, such as wealthy professionals or low income wage earners. Industrial parks and shopping centers will be the focus around which residential areas form. In those areas in which technological change results in major unemployment, the affected communities will quickly exhibit processes of environmental and social decay similar to those which occurred in the city.

Sociocultural—In the CBD, major cultural attractions, such as plays, concerts, and first-run movies, will become a thing of the past as these activities are shifted to dispersed suburban locations. Having lost its cultural focus, the CBD will become known as an area of crime and poverty. The population of the overall area no longer will look to the city for identity or direction.

Within the city proper, the poor, the unemployed, and the racial minorities will increasingly dominate the city government. This will lead to growing disputes between the city and suburbs over educational policies, industrial locations, taxation, and welfare. The changing composition of the electorate will result in a different set of priorities for the city, thus exacerbating even further the differences with the suburbs.

Suburban areas will become homes to the new cultural centers drawn away from the central city. These cultural centers will be widely dispersed over the suburban areas, but will attain a new element of unity in their dependence upon the automobile. Despite this element of unity, suburbs will begin to vigorously compete with each other for future cultural facilities. The resulting duplication and redundancy will lead to new peaks of excellenece in some areas of endeavor and new depths of mediocrity in others.

Supporting services—The reduction in commercial activity and the loss of tax revenues in the CBD will cause a rapid deterioration of public services, such as police and fire protection, water, refuse collection, sewerage, and so on. This deterioration will serve to hasten the further departure of businesses, thus accelerating the decline of the area With the reduction of travel to the CBD, public transportation systems will contract and in most cases will disappear altogether People living near such areas will be forced to supply their own transportation Those unable to do so will remain in an ever-contracting area and will be almost isolated from the remainder of the city and the suburbs There will be strong backroom pressure from various outlying residential areas to keep public transportation minimal in order to isolate the city ghettos from the more stable neighborhoods

In the city proper, the deterioration of public services will follow the outward spread of urban decay This spread will be anticipated by middle class residents in unaffected neighborhoods, causing them to flee to the suburbs, and hence accelerating the overall process. Declining tax revenues coupled with increasing demands for higher wages among the city employees will cause a continual series of crises in the city. Some cities will collapse, in effect, and only the reluctant intervention of the federal government will prevent widespread riots

People in the suburban areas will be watching closely the above process of urban deterioration. This will prompt them to take

radical, but largely ineffective, measures to prevent similar situations in the suburbs. The most significant effect of these measures will be an unintended heightening of racial tensions, community separateness, and overall inefficiency in regional development. The increasing demand for city-type services by suburbanites will cause many suburbs to become microcosms of cities, but with all of the worst urban tendencies for disintegration and few of the traditional urban mechanisms for conflict resolution.

The above scenario, of course, is only hypothetical. Furthermore, it is based on only one of many possible interpretations of existing trends in American cities. Other interpretations and other extrapolations may well produce other scenarios with differing general conclusions. The overall assumptions or specific details used in the prediction are not as important here as the fact that the above scenario is taking place at the present time. The existing processes within it may be less than fully active, but to some degree all of the trends described above can be found in American cities, and the future indications, quite frankly, are not promising.

The Potential of the Future

As seen in the previous section, the extrapolationist view of the city is not a particularly encouraging one. In that view, however, two assumptions were made which bear examination: (1) that the future of the city will be affected primarily by an internal interplay of economic forces and (2) that the image of man which perpetuates the present functions of the city—economic and sociocultural—will remain the same.

With regard to assumption (1), the future of cities cannot be discussed without considering the global trends which are rapidly converting this planet into a single community. Previously, human settlements were relatively autonomous, but within the last several decades there has been a growing awareness of the increasing global interdependence of institutions, organizations, and technological and human service systems. World communications permit the sharing of cultural experiences on an unprecedented scale. Global transport systems carry diverse mass-produced goods to all parts of the world, and these goods bring with them shared attitudes and cultural patterns. World tourism has shown an increase from 22 million international visitors in 1950 to nearly 100 million visitors in 1968 (18, p. 49).

...she had never before seen a rabbit with either a waistcoat-pocket, or a watch to take out of it, and, burning with curiosity, she ran across the field after it, and was just in time to see it pop down a large rabbit hole under the hedge.

In another moment down went Alice after it, never once considering how in the world she was to get out again.

The rabbit hole went straight on like a tunnel for some way, and then dipped suddenly down, so suddenly that Alice had not a moment to think about stopping herself before she found herself falling down what seemed to be a very deep well.

--Lewis Carroll

The diffusion of human service networks has been accompanied by the development of international regulatory agencies, such as the international postal union, the world network of health agencies which monitor and control epidemics, agencies which regulate allocation of telecommunications wavebands, and transportation regulatory agencies controlling the use of airways and sea lanes. Finally, global emergence of a single culture is a by-product of the recent rapid growth of multinational corporations—unprecedented in size, extent of markets, and relative independence from the constraints of national boundaries (18, p. 51).

These trends, collectively referred to as the "Geosocial Revolution" (10, pp. 167-206), have been invisibly shaping the course of life in this century. Only recently have they been noticed because the changes are so vast and so historically unfamiliar that specialists have failed to perceive and integrate the diverse components. Insofar as urbanization is regarded as a process in which man becomes increasingly dependent upon his own man-made synthetic environment of integrated resource-supply systems, this geosocial revolution must be regarded as the latest phase of urbanization. Like earlier phases of urbanization, the transformation of physical systems and services in the environment brings with it a challenge to the previous modes of sociocultural organization; the old image of man must be displaced or assimilated by a new one in order for the whole system to function.

As described earlier, the first Urban Revolution, which occurred about 3000 B.C., involved the convergence of two images of man—one associated with the earlier

paleolithic hunting tribes and the other with the later agrarian, neolithic village. These two images—man in motion and man at rest—remained as important components of every subsequent image of urban man. Nomadic man was traditionally a threat to the cities, and modern transportation has all the characteristics of a nomadic invasion:

> The devastation which follows in the wake of the nomads is one of the themes of ancient history, but it is also a phenomenon of our own times. Mobility overrides all the values which stand in its way (3, pp. 9-10).

In contrast to this commitment to mobility is a balancing commitment to rest, to a place, and to the land, which also has persisted throughout subsequent images. Until the development of the industrial city, whose real economic basis lay in the inventive utilization and transformation of energy sources, land was the foundation of wealth and security. The industrial paradigm assimilated the agrarian attitude toward land: a belief in its sacredness and a confidence in its immediate, tangible, and local character. It follows from this attitude that the strongest government should be local. For the agrarian mind, community responsibility, law and order, justice, public service, and social welfare are tied to the function of land (17, p. 71). The belief that the noblest work is hard physical labor, the ethos of competition and rugged individualism, the disdain for the poor (who must be lazy if they do not own and work land) are aspects of the commitment to place. Insofar as these attitudes persisted through the late industrial era, they produced a lag in the sociocultural image.

But many of the characteristics of the industrial state paradigm, shown in Table I-VI, including these residual agrarian attitudes, continue to persist into the emerging global urbanism. Certainly a new image is required, one which would enable man to rely more upon organizational place rather than on physical space, and which would emphasize cooperation instead of rugged individualism, as suggested in Table I-VII.

If the new image of man is to be radically liberated from land-locked agrarianism, perhaps it is to be derived from the concepts of cybernetics. Thus, man can be viewed as a process, a flux, a pattern that persists in time

TABLE I-VI

Characteristics of the "Industrial-State" Paradigm.

+ Development and application of scientific method; wedding of scientific and technological advance.

+ Industrialization through organization and division of labor; machine replacement of human labor.

+ Acquisitive materialism; work ethic; economic-man image; belief in unlimited material progress and technological and economic growth.

+ Man seeking control over nature; positivistic theory of knowledge; manipulative rationality as a dominant theme.

+ Individual responsibility for own destiny; freedom and equality as fundamental rights; nihilistic value perspective; individual determination of the "good," society as an aggregate of individuals pursuing their own interests.

Source: (15, p. 84)

TABLE I-VII

Suggested Characteristics of the Emergent P radigm.

+ Complementarity of physical and spiritual experience; recognition of a. 'explanation" as only metaphor; use of different noncontradicting "levels of explanation" fo physical, biological, mental, and spiritual reality.

+ Teleological sense of life and evolution having direction/purpose; ultimate reality perceived as unitary, with transcendent order.

+ Basis for value postulates discoverable in own inner experience of a hierarch of "levels of consciousness;" potentiality of supraconscious as well as subconscious influe .

+ Goals of life—aware participation in individual growth and the evolutionary p ess; individual fulfillment through community; integration of work, play, and growth.

+ Goals of society—to foster development of individuals' transcendent and emergent potentialities. Economic growth, technological development, design of work roles and environments, authority structures, and social institutions all are to be used in the service of this primary goal.

+ New naturalism, holism, immanentism; rediscovery of the supernatural; the counterculture is essentially an exploration of the politics of conciousness.

Source: (15 p. 86)

and as a self-organizing energy/information exchange system. His city, likewise, is no longer merely a visible shell: its invisible organizing pattern of values and information is infinitely more important. Mankind has long since passed the point where it could survive without the artificial environment it has created. Urbanization, then, can be regarded as an ecological process in which science and technology (intelligence) are employed to increase the capability of the environment to meet the needs of man. As the process goes on, and as more and more information about the environment is encoded in human symbolic (artistic and scientific) systems, the information itself becomes the instrument which directs future development and sets the goals of the system.

To sum up, a transformationist view of the future of the city is that there is an image of man on the horizon which would give meaning to the following tendencies: (1) the trend away from local territorial sovereignities and towards a single global community; (2) the emerging city as an open, syntropic (anti-entropic) energy/information system with increasingly energy-efficient physical forms; (3) the management of changes (planning) in the controlling pattern of values and information which determines the resultant forms of social, political, and cultural modes; and (4) increasing concern with human values and the evolving potential of man.

III. Goals

The Need for Transportation

In the beginning, man was without wheels and was severely restricted in his mobility. Yet, he was not stationary or immobile. When he traveled he moved slowly, for short distances, took long amounts of time, and expended a great deal of personal energy Nonetheless, despite such limitations, man traveled.

Why did early man travel? He traveled because some of the things he needed and

wanted to satisfy his physical, emotional, and intellectual requirements were not in the place where he was. So, he traveled to obtain them or in the hope that he would find them.

Man is distinguished from other animals by his mind, his intellect. His ability to conceptualize and think sets him apart. Instead of adapting physically, man has been able to modify his culture (the common patterns of thought and behavior), especially his technologies in order to survive. Man's imagination and curiosity enabled him to develop culture and technology which aided him not only in surviving but also in exploring his universe. Thus, travel served not only to assist in man's physical survival, but also as a means to expand man's mind.

Today, man has many modes of transportation, and he is at his most mobile when compared to men in any previous era. He can move at greater speeds, over greater distances, in a shorter time, while expending lesser amounts of personal energy. The main reason man is so physically mobile today is because of his imagination and the realization of it through technology. The spiral has been continually upward: man's desire for mobility has engendered technologies which, in meeting the desire, increased both physical movement and the desire itself, which in turn demanded even better technologies.

But, why does man travel today? What functions does physical mobility perform? If pressed to answer this question, most individuals could compile a list that contained many of the following items: man travels to get to and from work, shopping, recreation, social activities, and to obtain commodities and distribute goods. These are valid and correct reasons for travel. Historically and currently, one reason that travel is necessary is because of the spatial separation of things (home, work, shopping, recreation, farm supplies) in the physical environment. Travel is a way of overcoming distance and is viewed not only as a means to an end, but also as an end in itself.

Another significant set of reasons for travel can be found in the culture. The American culture (and in fact most, if not all, present cultures in the world) places a high value on travel. In it, travel (physical mobility) is valued becaused it is viewed as indispensable to subsequent social mobility (improvements in economic and social position). Travel is valued as a means of escape and as a means of broadening both the experience and the mental mobility of the individual. Moreover, in such a culture physical mobility not only serves as a means to social and mental mobility, but also is often equated with the latter forms of mobility. Travel has become (or maybe has been for a long time) a desirable end in itself, an activity that is substituted for doing something else. In short, one often equates **going** with **doing.**

Traveling is viewed as an activity which accomplishes something. Physical mobility takes the place of doing or is performed in lieu of doing. In everyday language one often speaks of doing in terms of going, and in fact equates non-movement with not doing anything. For example, consider these typical answers to commonly asked questions:

> Q. What are you **doing** this weekend? A. I'm **going** to the beach. Q. What did you **do** last night? A. Nothing. I **stayed** home.

Responses such as these are illustrative of the premium that is placed on travel and of the notion that travel brings the good life. Man has been socialized and acculturated to accept one form of travel, physical geographic mobility, as a highly valued goal. The jet-setters, the world travelers, those who have seen the world are envied and esteemed. Given the opportunities and the resources, most of the remainder of society would spend more time going.

Most transportation studies and plans have attempted to improve transportation—to move man faster, in less time, save fuel, at less cost. New modes are developed, existing modes are revised, changes are made that will allow better use of existing facilities and technologies. These efforts are directed toward better accommodation of the need and desire to travel. Nevertheless, does man need to improve transportation systems? Perhaps, one might look at ways in which transportation requirements can be reduced and possibly eliminated. Man may have reached, or be fast approaching, an upper limit in terms of better transportation systems. Perhaps, further maximizing speed or lessening congestion is impossible without increasing ecological, economic, aesthetic, and psychological damage. The social costs of improvement may be too great.

The contention here is that much of the existing travel is unnecessary and can be eliminated. But, travel cannot be eliminated easily. Both a restructuring of the physical environment (to reduce spatial separation) and a restructuring of cultural value orientations and institutional patterns are needed in order to make travel less desirable and to reduce the necessity to be physically mobile. In fact, if cultural reorganization were substantial, much

travel could be reduced without any restructuring of the physical environment.

If the assumption is correct that man is a thinking animal and is capable of yet another cultural adaptation, then perhaps he can realistically find ways to maximize his intellectual curiosities and social yearnings in ways other than through physical mobility. Two reasons for so much current travel are that it is a way man learns and advances. Rather than through physical movement, there is the need to enhance social and mental mobility through other means.

What is required is a resocialization and acculturation to new life styles, different orientations, and a new psychocuitural mind set. This will require a recognition that travel is multidimensional in nature (does not consist merely of physical movement through space). Different forms of travel have been devised to deal with various forms of distance (personal, social, political, as well as physical). It may be possible to deal with the non-physical as well as the physical forms of distance through non-physical forms of travel.

Man is now in an era of transition to, hopefully, *a new Renaissance*. The challenge is to foresee what potential lies within this future and then strive to bring it about. Much has been written about cultural lag (where the technology advances much more rapidly than the non-material culture) and resulting culture shock (where pronounced lags create dislocations, breakdowns, and possibly even collapse). What is being proposed is that society consciously work to change its values and the non-material characteristics of its culture.

Assuming that the revolution cannot be brought about overnight, it might be useful to examine both immediate and long term cultural and institutional changes that could be instituted to reduce the need for physical travel. If this idea merits further development, both the goals and the methods of implementation by which it could be realized should be suggested.

Urban Goals

Urban areas provide numerous opportunities for human interaction and fulfillment provided one can get to them or have them brought to him. Freedom of choice and the variety of individual experience epitomized in urban areas cannot be realized by the immobile. Variety and dispersion, coupled with large population concentrations which attempt to make maximum use of scattered urban opportunities, have resulted in problems of accessibility and mobility.

As cities and urban regions grow in population, industry, economic importance, and geography, they become more complex, more uncontrolled, and more disorderly. While urban planners and decision-makers attempt to deal with the problems arising from complexity and disorder, their primary and overall goal has been, and still is, to **improve the quality of urban life**. This goal is abstract, ambiguous, and sufficiently vague so as to be useless in guiding the formation of public policies and programs.

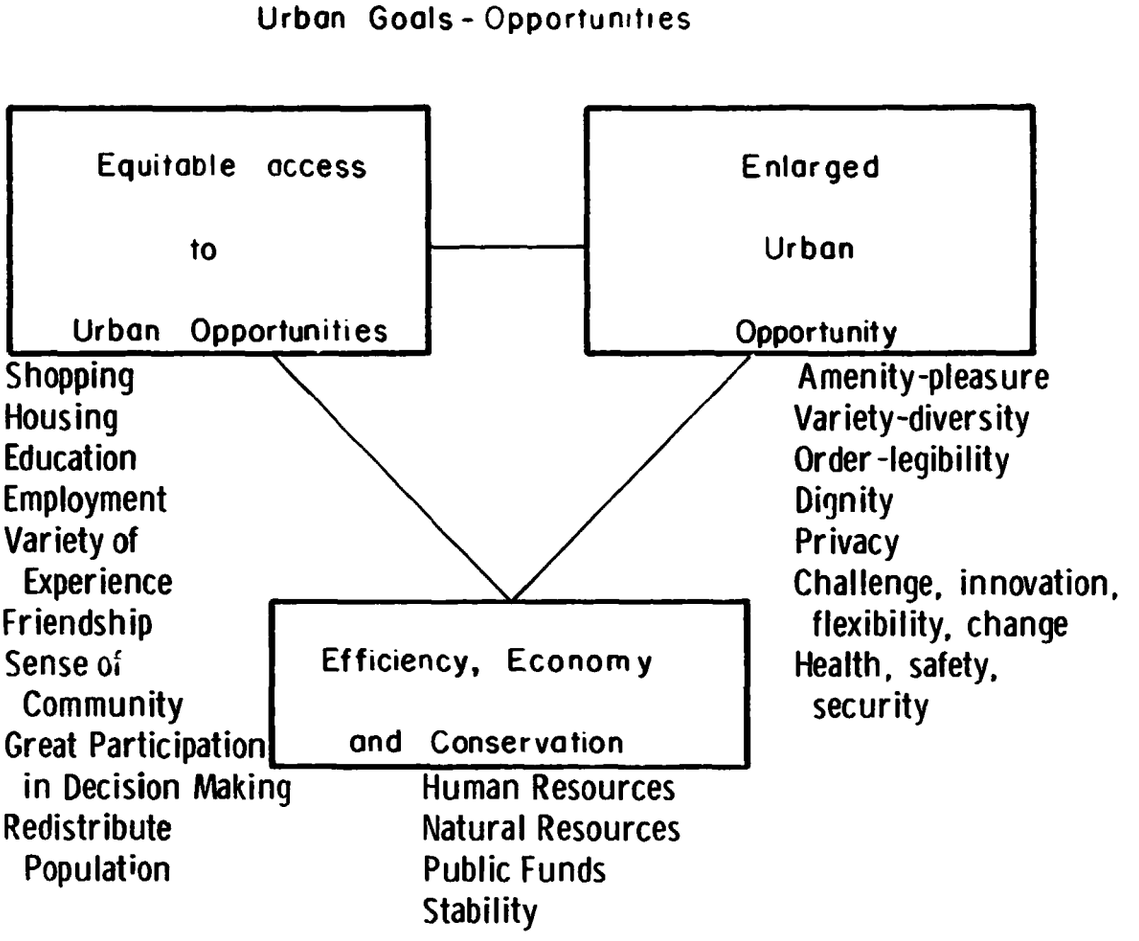
Under the overall goal of improving the quality of urban living, numerous sub-goals have been articulated as constituting a desirable urban environment. One accepted articulation suggests three basic genre: (1) enlarged urban opportunity; (2) efficiency, economy, and conservation; and, (3) equitable access to urban opportunity. These are shown in Figure 1-3.

Although commonly accepted, attempts to deal directly with these goals have rarely been undertaken. The task of achieving major urban goals is a monumental one. Cities are not built overnight, and only rarely are they built from scratch. Changes in the urban environment are usually marginal and undertaken by diverse political jurisdictions comprising a multitude of interests. Noticeable changes in the urban environment result from many, sometimes conflicting, actions taken over long periods of time. The time span generally far exceeds the usual term of office and span of vision of those who make urban changes.

Transportation Goals

The urban system is too complex and overwhelming to allow for complete comprehension and understanding. Unable to deal with it directly and as a whole, planners (perhaps necessarily) have tended to deal with urban ills on a piecemeal basis, often looking to transportation as a palliative. Wilfred Owen has noted that "since no one is responsible for creating whole cities, transportation is called upon to make disorder viable" (22, p. 53). As long as transportation is efficient, it can permit and even compensate for the disorder and accidental nature of the urban region. Improvements in transportation have only made the disorder liveable and, in fact, often have permitted greater disorder.

As a result of this approach, goals for transportation have evolved from the more general urban goals outlined above. When focusing on transportation goals, decision-makers tend to be more at ease dealing with matters within their institutional jurisdictions, span of vision, and time framework. In doing so,



SOURCE: (34, pp. 633-649).

FIGURE 1-3
PLANNING FOR URBAN CHANGE

they abstract only one system and usually assume away or discount a number of interrelationships between subsystems. Thus, the generic goal of "equitable access to urban opportunity" has been translated, often rather narrowly, into a "transportation" problem, and today it is viewed, analyzed, and "solved" as such.

The goals of transportation planning are a reflection of what planners, decision-makers, and opinion shapers perceive them to be. Like other processes of human development, these goals are in continuous flux, within an environment of change. They are assumed to reflect the values of society at large; values which themselves are continuously evolving. Traditionally, these goals have reflected the contention that transportation is a sufficient palliative to negate the need to understand the causes of "disorder." Minimal attention generally is paid to "prevention"—the demand for movement and by considering movement in the context of urban opportunity.

Urban transportation goals are viewed in terms of:

(1) Saving time in travel;
(2) Reducing operating costs;
(3) Efficiency in the use of resources (as in construction costs);
(4) Comfort and absence of strain, noise, nuisance;

(5) Increasing the productivity of the economy;
(6) Flexibility;
(7) Reducing congestion; and,
(8) Safety.

Some of these goals are ill-defined and even misleading. While "saving time in travel" is considered a goal of transportation planning, any observer knows that man has not been striving to do so. When a faster travel mode is made available or when transportation network speeds improve, man has opted to travel greater distances. Goal (1) above may be synonymous with "encourage" urban sprawl"—a goal rarely articulated.

Reducing congestion (as in building new highway lanes) is another example of the problems encountered in attempting to achieve the above goals, since it usually attracts more induced and diverted traffic. The positive feedback loop only creates more congestion.

Changes in societal values and an emphasis on social priorities over time have been influential in adding additional transportation goals to the list. This new emphasis has emerged through a succession of public pressures, which were triggered by "externalities" resulting from the previous emphasis upon a narrow definition of transportation. Additionally, the poverty crisis and the riots of the 1960's introduced an emphasis on mass transit and community development, with the addition of such goals as:

(9) Minimizing disruption to communities and activity patterns;
(10) Ability to move about without an automobile; and,
(11) The right to transportation for the elderly and the handicapped.

The environmental ethic generated such goals as:

(12) Minimizing air, water, and noise pollution; and,
(13) Aesthetics.

The energy crisis precipitated the goal of:

(14) Minimizing wasteful used of scarce energy resources.

And finally, an emerging emphasis on orderly land use has led to the goal of:

(15) Promoting and guiding sound land use.

These latter goals are prominent at a time when conventional transportation planning is under attack for its narrowness of approach. Not only are people becoming dissatisfied with the performance of the transportation system, but are also critical of the transportation planning process and the solutions resulting from it.[2]

The transportation system is being rediscovered as part of the larger urban system: the goals of transportation and the goals of urban society are interdependent. Decisionmakers at all levels of government, realizing this relationship, are also facing public pressures for more orderly and rational use of the surface areas of the Earth.

These emerging priorities are expected to yield new approaches to a combined transportation/urban life system of goals. For example, Owen wrote that

> What is needed is a way to combine transport with other urban programs, to influence the demand for movement, and to substitute proximity for propulsion. The goals of better housing, access to jobs and recreation, and other community improvements should be the guidelines for transportation policy (22, pp. 52-53).

Many kinds of urban futures are possible, and transportation will play a large part in promoting or hindering their determination.

Optimally, future solutions to urban ills and transportation problems will attempt to combine the following elements:[3]

(1) Technological Advances
—Transit innovations and revised modes
—New power sources
—Telecommunications

(2) Changes in Design of Communities
—Cities that substitute planned activity systems for travel
—Good housing, employment, and environment replacing the desire to escape
—More efficient political decisionmaking

(3) Changes in Values and Life Styles
—Revised work-play rhythms
—Increased leisure time
—Changed perceptions in the use of space

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[2] For example see (22, p. 53)

[3] Wilfred Owen has argued for the first two elements in (22, p. 131). Russell Train, Director of the Environmental Protection Agency, has echoed these arguments and has called for the redesign and reconstruction of cities in order to cure urban transportation ills (35, p. 1050).

Planners and decision-makers face what may be an impossible challenge—the intelligent management of change. Richard Sennett has argued that planning has been guided historically by two simplistic and disputable assumptions. The first is that the social, economic, and physical phenomena of the city are interrelated and, therefore, should be dealt with jointly and as a whole. The second holds that changing the physical structure to influence or change social patterns is easier and preferable to changing first the social structure and then the physical structure (25, p. 90).

The unified and holistic approach to planning requires the planner to determine unmet and "projected needs" of the urban area and then to design social and economic facilities (the "parts") to meet them. Planning from this perspective has failed because plans have not been adaptive over time and have been unresponsive to change.

Perfect solutions will always elude the planner, but he should strive to achieve the best possible solutions. This will require explicit recognition of desired goals and careful analysis of the consequences of adopting alternative solutions to reach them. Future solutions hopefully will consider both improving means to facilitate travel and reducing the demand for, and the need to, travel.

IV. Planning

The Management of Change

Planning can be defined as the management of change or as thoughtful action to produce desired change. What is critical to an understanding of the concept is that *planning is an attempt to control the future* The nature of the type of future desired by the planner and his society is highly subjective and is dependent upon factors such as the ideology, philosophy, implicit value sets, and basic understanding of the planner, as well as the planning methodologies available to him. Each of these factors provided for a range of possible directions and corresponding futures. The sum effect of all the factors, however, results in a relatively limited set of planning outcomes.

If factors influencing the planner were static, one could predict the type of "thoughtful action" a given planner would exhibit towards future changes. Just as changes in individual values and environmental conditions herald modifications in both transportation systems and the entire urban sphere, so also do such changes cause adjustments in factors influencing the planner. As time passes and knowledge increases, planning methodologies improve, values change, and even ideologies undergo reformulation. The process is one of long-run continual flux, although in the short run there may appear to be a high degree of stability and even ultimate resolution of these factors. This dynamic quality should be kept in mind during the following discussions of factors influencing the planner

Ideology

Planning occurs within a society which has a given set of ideological commitments involving accepted beliefs about the roles of both individuals and representatives of societal interests. The very existence of these beliefs imposes constraints upon the nature and extent of planning acceptable to a society. Attempts to overturn strongly-held beliefs or to transcend the boundaries of acceptability are likely to be resisted by the society and labeled as heretical or radical. Therefore, in order to understand the role of planning in the management of urban change, it is useful to obtain an overall perspective of the ideological framework within which such planning occurs.

A discussion of existing ideologies must focus on some critical characteristics common to all in order to make useful comparisons. In the case of planning ideologies (the planning components of the more general socio-economic-political ideologies), the key for comparison is control. Although a single linear dimension may oversimplify what is a highly complex variable, for the purposes of this discussion it is useful to consider control as the degree of choice exercised by the individual. Choice may vary from full control, in which the individual may be viewed as completely dominant, to no control, in which the individual is completely subservient

Control over choices may be characterized further in political terms as being a continuum having one extreme of absolute control by the individual over those parts of the world to which he relates and another extreme of absolute centralized control by society over all individuals. This continuum, shown in Figure 1-4, includes among other things, the control of individual actions, of physical resources, and of the delegation of political power Since these choices are precisely those which control the future, and since this is the basis of the planning process, the specific role of planning in any society is dependent upon the overall ideology from which it is derived.

Although no existing society is at either

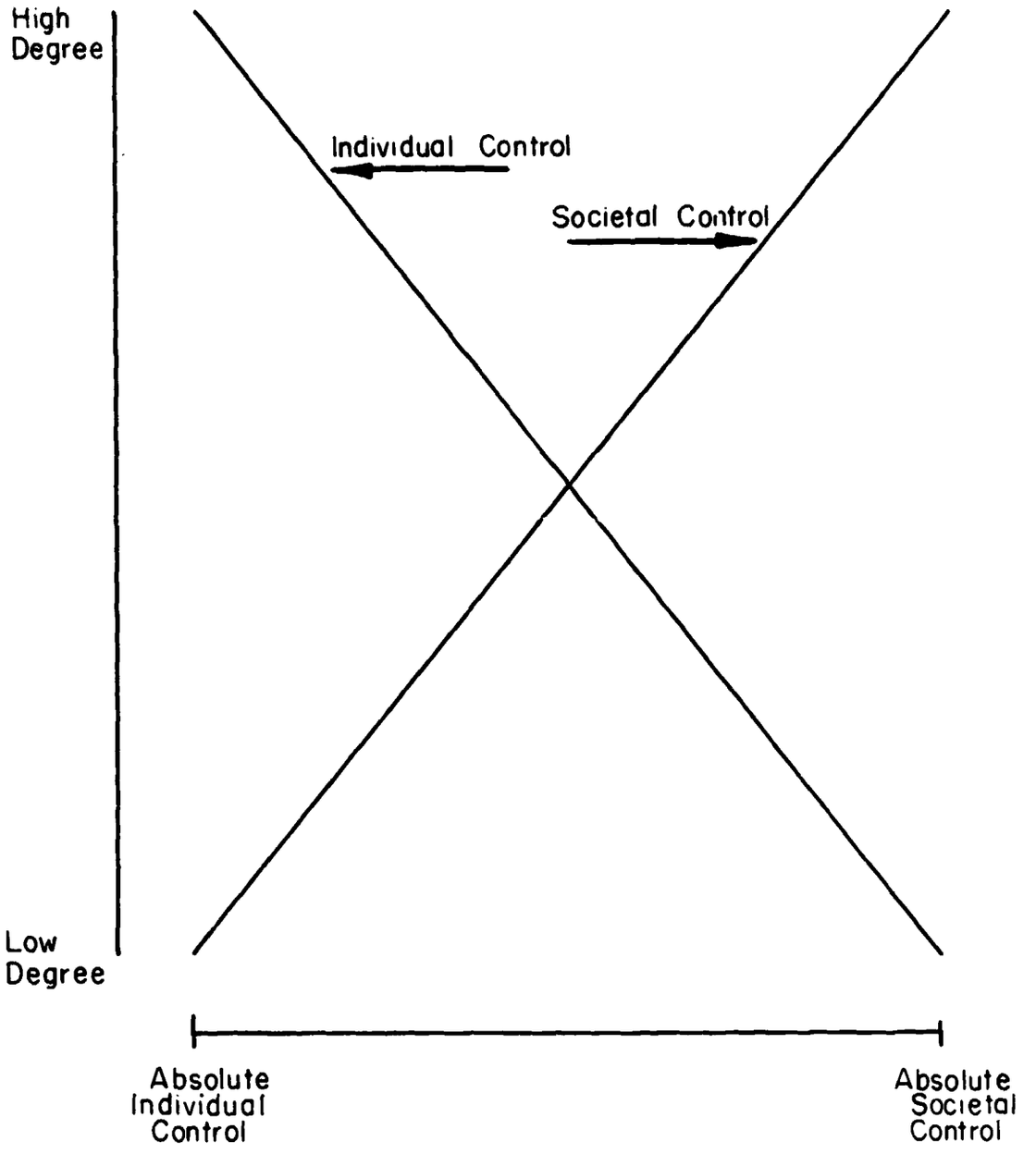

FIGURE 1-4
INDIVIDUAL versus SOCIETAL CONTROL

end of the continuum, there are many examples of social groups illustrating widely divergent mixes of the elements of individual and societal control. Perhaps closest to the pole of individual control is the now-vanished frontier world of fur trappers, voyageurs, and mountain men in the 18th and early 19th centuries. In this era, social interaction was minimized, and individuals consequently were able to make their own choices with regard to little other than the

limitations imposed by their physical environment. Few, if any, modern societies exhibit a comparable degree of individual independence. On the national level, the best example of a high degree of individual control probably is that of the United States, where individual choices retain much of their early pioneer dominance and societal control remains relatively minor, although continually increasing in influence. There is a tendency for centralized direction to be concentrated in areas where growing social interaction and interdependence accompanying industrialization and urbanization have led to public demands for some societal restraint on individual choices in order to reduce the adverse effects of the actions of one individual upon the lives of others.

The twin notions of interdependence and of the individual being an element of a collective whole are perhaps the strongest motivations for shifts towards the societal control end of the spectrum. National policies having a greater degree of centralized control than the United States include most of the industrialized nations of Western Europe as well as Japan, Canada, and much of the newly-independent developing world. The Scandinavian countries, for example, have large private industrial and commercial sectors along with extensive social welfare measures intended to guarantee a minimum quality of life. On a much smaller scale, the modern western industrial corporation exhibits a similar, if not even stronger, tendency towards centralized control of all major issues. This is considerably more societal control than that found in the typical American city and even more so than in the relatively young planning departments found at the level of local government.

Examples of a high degree of societal control, with a consequent low amount of individual control, include both those nations adhering to the principles of Marxist socialism and those ruled by strong military regimes. The Soviet Union, China, and Cuba are representatives of the first category, in which the concept of the dictatorship of the proletariate is translated into central control of almost all societal functions. In this system, the individual exists to serve the state and to help achieve common goals of material welfare and equality. Nations ruled in recent years by military regimes include Nazi Germany, Portugal, and Greece. These regimes were the antithesis of Marxism, and often were justified solely on the basis of their opposition to Marxism. Furthermore, they tended to be oriented towards the status quo, devoid of a motivating ethic for desirable institutional change, and normally existed primarily for the benefit of a few vested interests. Despite these philosophical differences between Marxist and military regimes, control over choices is highly centralized and the individual is subservient to the center in both systems.

Even greater degrees of rigid central control can be observed in smaller social groups, such as most military and religious organizations. Although the concept of individual conscience and responsibility may be theoretically maintained, in practice individual deviations from established central norms are strongly resisted and often severely punished.

In the spectrum of ideologies sketched above, one clearly can see different roles for the planner. Where central control is dominant, the planner conceivably may take on the roles of decision-maker, implementer, and even evaluator with regard to planning choices. At the other end of the spectrum, he may be able only to advise or at best pursuade others to take certain courses of action. The degree of control dictated by the prevailing ideology, therefore, must be kept in mind when one attempts to define the role of planning for transportation or urbanization or any other type of social change.

Values

Planning—the management of change—is the formal process by which accepted methods of evaluation are used to assess alternative future options regarding a system. Choices are made with respect to these options and finally recommendations are presented for the attainment of desirable future changes.

The system of concern here is the modern urban environment in general and the transportation network in particular. The transportation network can be considered a public system since it serves the entire urban community, both directly in the form of the movement of people and goods and indirectly in the form of its influence on both spatial and social relationships. Planning in the context of such a system can be described in terms of basic assumptions regarding planning functions as well as the implicit value sets linking planning style to the society in which it operates.

Basic Assumptions

If individuals or groups are to allocate resources to planning, they must expect benefits to accrue as the result of their efforts. Three basic assumptions must be made to insure that planning will yield benefits. First, there must be an expectation that the planner will be able to predict the probable outcomes of

various plans. Second, there must be an expectation that the planner wi be able to differentiate on the basis of these predictions and choose among the alternative outcomes. Finally, there must be an expectation that the planner will have some influence upon the adoption of the chosen plan.

The need for the first assumption seems obvious. If the planner wishes to manage change, he must be able to predict the consequences of alternative outcomes of various plans. If prediction were not possible, change would come about in a random manner. In most American cities, despite various planning efforts, random processes of development seem to have dominated the results. The long range solution may well lie not in eliminating planning but rather in improving the predictive capabilities of planners.

The necessity of the second assumption—the ability of a planner to choose among alternatives—also is apparent from the earlier definition of planning. The successful management of change requires that the planner be able to select desirable outcomes and reject undesirable ones. This implies some set of selection criteria to make the choices consistent rather than random. Although the criteria for urban planning may be highly subjective in nature, the mechanics of determining planning choices can be largely objective, as well be discussed later in this report (Chapter III).

Finally, the third assumption—the ability of a planner to influence the adoption of a plan—also is necessary for the successful management of change. Influence involves many degrees of control, and may range from simple expression of personal preferences to direct manipulation of public resources. Without some influence over the final outcome of the plan, the planner would have great difficulty in maintaining the necessary relevance in his work.

Implicit Value Sets

In the United States, implicit planning values can be found in the issues of societal control, objectivity, realism, and concern for future options. These issues normally are not explicitly stated in planning documents, but their presence affects the entire style of planning. The following describes the four most important value sets currently operative in this country (although actual planning outcomes may not necessarily reflect these values):

(1) **Societal control**: Dictatorial direction is to be minimized because both individual and group preferences are respected. Where necessary, compromises are reached between conflicts of interests between individuals, groups, and planning organizations. The planning process should be subject to influence by the intended beneficiaries. Planning by a public agency is for the benefit of the affected people in general and not for the exclusive benefit of the agency.

(2) **Objectivity**: Plans should emphasize objectivity, whereby the facts determine the outcome of an issue. In planning for a particular social group, beneficial changes are maximized and adverse changes are minimized. Subjectivity based upon unsubstantiated preferences of the planner or some other group is to be minimized.

(3) **Realism**: Plans are to be prepared on a realistic basis, taking into account the exigencies of each particular situation. Radical creativity in plan formulation is discouraged, since only the conventional solution is normally accepted

(4) **Concern for future options**: Beyond immediate planning outcomes, there is concern for the availability of future options in terms of resource usage, methodological variation, and behavioral modifications. The conservation ethic of recent years is a prime example of such interest in maintaining a variety of choices for future generations.

Planning Philosophy

From the basic assumptions and implicit value sets above, a generalized philosophy and sequential approach can be outlined for transportation-related planning in the United States. The assumption is made that the fundamental purpose of any plan promulgated by a public institution should be to achieve the greatest degree of benefit for the affected community. This benefit includes all types of favorable consequences resulting from the plan, but the decision as to what is favorable and what is unfavorable must be left to the preferences of the individuals within the community. A planning outcome perceived by the affected community as unfavorable cannot be defined by the planner as favorable. Thus, unpopular, externally-imposed plans are unlikely to produce favorable results from the standpoint of the affected population For the planner, therefore, a transportation plan should maximize the social welfare of individuals in terms of their own preferences, should be free of dictatorial direction, and should achieve these objectives with the minimum expenditure of resources.

From a practical standpoint, transportation planning involves the basic questions of "Who

decides?" and "What and how much?" The former refers to the decision-makers influencing plan formulations, while the later refers to the nature and extent of the plan. The decision-makers include: (1) plan initiators, such as politicians and government administrators; (2) planners, the experts dealing with the technical aspects of the problem; (3) plan users, all those directly using the transportation system resulting from the plan; and (4) the indirectly-affected community, all those whose welfare is influenced by the indirect effects of the plan

The nature and extent of a plan greatly depends upon the influence wielded by those controlling physical resources, the planners formulating alternatives, and the politicians and government administrators controlling, or at least responding to, political power. The necessity of reconciling the desires of these groups, other special interests, and the diverse elements of the public should result in plans which are realistic compromises for the given conditions. This realism, which in the past often has been based solely on the short run considerations, is becoming increasingly tempered by considerations of consumer protection, environmental quality, and resource conservation.

An overall seven-step sequence describing the process of transportation planning in terms of the above assumptions and values might be as follows:

(1) **Identify and define the plan objectives.**
These objectives usually are given in crude form to the planner by some political or governmental authority. (Example: Alleviate transportation problems between points A and B.)

(2) **Identify and define a rationale for the given objectives.**
This involves the determination of the implicit, but normally unstated, reasons for the original objectives given by the politician. (Example: A solution is required because of increased demand for travel between A and B and because of present difficulties in satisfying that demand.)

(3) **State the fundamental propositions to which the planner will link the given objectives.**
This step involves the perceptions of the planner with regard to the relationship between transportation and social welfare. These perceptions will consititute his planning philosophy and will affect his choice of planning alternatives. (Example: The planner may evaluate the benefits of a rapid transit link to be relatively minor in terms of reduced highway congestion but relatively major in terms of providing increased mobility to a poor, economically-depressed community. His fundamental proposition in this case may be that a transportation input can and should be used to bring about indirect socio-economic change in the community.)

(4) **Identify, define, and predict changes resulting from different inputs to a transportation plan.**
Planning involves choices of what are hoped to be directed and controlled changes. The type and magnitude of possible changes must be known if rational choices are to be made. The types of changes considered in the plan should not be viewed in narrow terms but should be defined as broadly as possible. (Example: Changes can occur in the technical sphere (passenger travel time), economic sphere (capital and recurrent costs), financial sphere (bond issues), social sphere (community attitudes towards mass transit), administrative sphere (the formulation of a transit authority), and the political sphere (the active assistance of labor unions).

(5) **Define the range of feasible alternative transportation plans and develop detailed alternative plans representative of the range.**
The alternative plans should be prepared with equal objectivity and in sufficient detail to allow inter-plan comparisons by the ultimate decision-makers. (Example: Plans should show alternative routes for highways and mass transit links.)

(6) ***Choose the optimum transportation* plan from the range of feasible alternative plans.**
In almost all cases, the planner has

the responsibility of recommending which of the alternative plans should be implemented. Such a recommendation should be fully supported by a clear presentation of the available data, the conclusions drawn from this data, and, where necessary, the unsubstantiated inferences used to reach this decision. (Example: The recommended transit link passes through an economically-depressed community. This decision could have been based on relatively firm conclusions that the new system will provide incentives for urban renewal.)

(7) **Influence the adoption of the chosen transportation plan.** Since the final adoption of a transportation plan usually is made by political decision-makers, the planner cannot directly control acceptance or rejection of a given plan. However, he can influence the final result through the preparation of the plan report, through his continuing solicitation of the plan report, through his continuing solicitation of citizens' input and participation, and through a general willingness to make his personal conclusions known to the ultimate decision-makers. (Example: The planner can defend the plan recommendations at public hearings and at informal meetings with public officials.)

The above sequence outlines only the process by which assumptions and values operate to shape a transportation plan. A final critical constraint is the set of methodological tools and models available to the transportation planner.

Methodology

Planning methodology includes procedures for data collection and assessment, schema for plan formulation, models for analysis and prediction, methods for plan evaluation, and choice criteria for plan selection. All are tools used by the planner in bringing order into a system and in determining choices for the control of future changes. A simplified outline of the transportation planning process is shown in Figure 1-5. The existing urban system in which transportation planning occurs is one of extreme complexity, and the choices arising from this milieu are limited to the extent that available planning methodologies fail to account for the real world. As a result, transportation planning in the past often was akin to narrow traffic design and only rarely was an integral part of comprehensive urban planning. Fortunately, this situation is changing, but substantive progress has been slow and the main problems remain.

Urban transportation planning is complex because of the interaction between land use

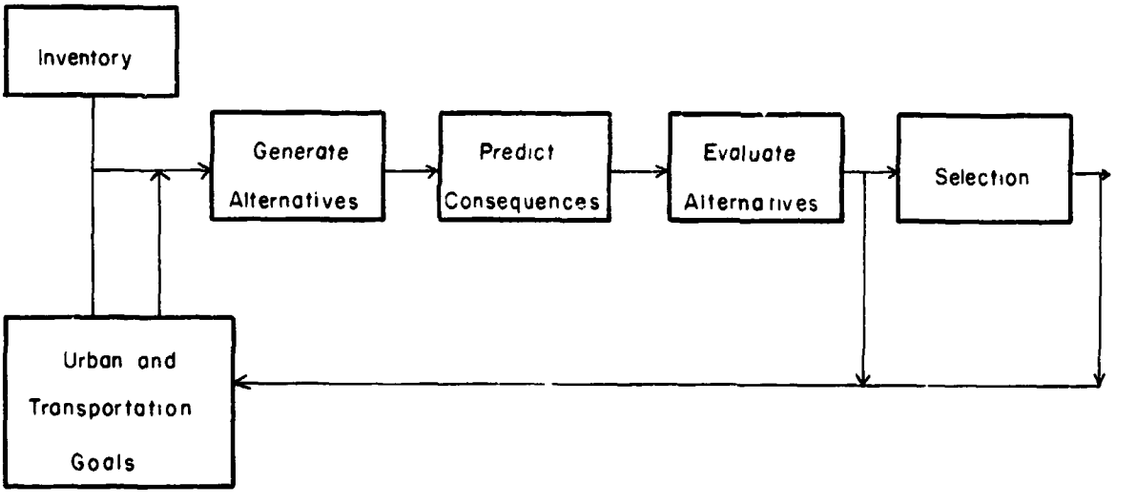

FIGURE 1-5
FRAMEWORK OF TRANSPORTATION PLANNING

and transportation, the wide range of choices in applying technology to improve transportation systems, the difficulties in sampling travel desires properly, and the uncertainties in forecasting future land use and future demand for transportation. Other problems include the selection of the optimum staging of improvements to transportation systems and the development of a continuous process for keeping transportation and land use planning up to date. Comprehensive urban transportation planning is a post World War II phenomenon. It originally consisted of a process of planning isolated facilities, such as roads, bridges, a line of transit, and so forth. Since each facility was considered to include the entire spectrum of planning and construction activities, there was no attempt to investigate the impact on other urban systems.

More recently, however, there has developed an interest in the study of total system interrelationships arising from different transportation facilities. The Federal Aid Highway Act of 1962 requires all that all federal aid funds approved after July 1, 1965, for highway projects in areas over 50,000 population be tied to a continuous, comprehensive planning process (36). This necessitates that the planning of highway projects considers the entire urban area and involves the active involvement and cooperation of all the local communities, counties, and the state highway departments. It also requires that the planning process be broad enough both to develop much more than highway programs alone and to provide plans compatible with local land use goals and the economic, social, and cultural objectives of the community.

The planning philosophy incorporated in recent federal acts has been translated into an institutionalized planning process which is based on a set of analytical and mathematical models (see Appendix E). The following eight steps usually are followed:

(1) Collection of land use, employment, economic activity, transportation facilities, and travel pattern data of existing situations;

(2) The establishment of quantifiable relationships between present day movements and the land use, economic and population factors;

(3) Forecasting land use, economic, and population figures for a future horizon date;

(4) Forecasting future patterns of movement and transportation demands, using the relationships developed in (1) and the predictions established in (3) above;

(5) Allocating future trips to different modes of travel (modal split);

(6) Assigning future trips to different routes available for each mode (traffic assignment);

(7) Evaluation of the efficiency and economic viability of alternative network configurations; and,

(8) Selecting one or a set of desirable transportation systems.

The use of the above process was pioneered in the Detroit Area Traffic Study (1953), the Chicago Area Transportation Study (1956), the Penn-Jersey Transportation Study, and the Tri-State New York Metropolitan Study. Subsequent studies followed in all major cities of the world. These studies had a heavy emphasis on data and computerized "models." They also are characterized by their high costs which range between $1.00-$1.50 per capita. The assumptions which are built into the conventional urban transportation analysis models have resulted in a number of shortcomings and weaknesses.[4] These shortcomings include:

(1) The models have not considered the whole transportation system but only those variables for which it was relatively easy to collect data. For many studies, only three types of variables, namely, economics, population, and land use have been used. The response of transportation systems to such variables as politics and human factors have been given little or no treatment in these traditional models.

(2) The equations in these models have been static and non-interacting. Future projections of these equations do not provide information for the transition period. There is a need to formulate dynamic equations that show time dependency and permit predictions for any future time. The equations also should show an interacting effect since the variables are interrelated in such a manner that a change in any one variable is propagated throughout the system.

(3) The models were developed basically for highway vehicles rather than an overall transportation system. For example, the traditional models for modal split were developed simply to divide trips into auto vehicle trips and transit passenger trips. In addition, existing models do not account for trips that will be taken by new modes of transportation now being developed and implemented.

[4] For a discussion of these weaknesses, see (30)

(4) Conventional model systems do not integrate present traffic engineering and control technology into the overall planning process. The analysis of short-run solutions to traffic problems (e.g., route capacity, traffic flow and control, etc.) is usually applied only after the overall planning has been completed.[5] The integration of concepts of "traffic management" into long-range forecasting and planning efforts hitherto has been neglected. The two technologies presently are viewed as two sequential steps, rather than a unified methodology.

(5) There is increasing concern that models place undue emphasis on large-scale planning and on region-wide transportation systems at the expense of community and neighborhood concerns. This has suggested the need for the recent emergence of increased community participation as a significant input into transportation planning. It has also prompted some recent conceptual shifts in both the priorities and scale of planning efforts. Such emphasis is manifested in improved and expanded methodologies for the evaluation of alternative proposals.

The above represents the major directions in which transportation planning methodology is moving at the present time. These directions basically encompass the development of policy-oriented models which are useful for exploring the consequences of both short-run and long-run proposals. The planning technology of the future hopefully also will be more dynamic and multimodal, will account for the role of human factors, and will be more responsive to community and neighborhood goals.

[5] For a coverage of traffic engineering techniques, see (6, 11, 29)

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2

TRANSPORTATION TECHNOLOGY

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Chapter II

TRANSPORTATION TECHNOLOGY

Introduction

For thousands of years, man's primary modes of transportation were his feet and water-borne logs (perhaps the first levitated vehicles). On land, when he did not walk, he learned to use various domesticated beasts: the horse, first tamed and ridden in Japan—its westward spread altered the political and social history of Europe; the reindeer and Lapp deer native to Siberia and the Lapps of northwestern Europe enabled the Tungus traders to travel enormous distances with well-trained teams; the camel made life and civilization possible in the oases of the Sahara; the Indian elephant with its great strength and intelligence was early used for transporting heavy loads for road and bridge building.

Each technological change in transportation brought with it new patterns of life, wealth, and power. As the horse yielded to the train and the horseless carriage, pre-industrial culture was transformed into the industrial age. Man took to the air in balloons, dirigibles, and airplanes. He has orbited the Earth and driven on the moon.

On land, the horse-drawn trolley was replaced by the electric trolley which in turn gave way to the motor bus. In the 1930's the bus was widely used for transportation, but now it has been replaced largely by the automobile which has become the predominant mode of land transportation. Once the automobile became established, it helped create a pattern of settlement that could not exist without it. There is general agreement that the privately owned automobile is here to stay, at least for the foreseeable future. Such forecasts are based on the ability of the automobile to provide maximum levels of convenience, privacy, comfort, and flexibility in getting people from their origin to their destinations whenever they so desire. The almost complete dependence on the automobile has, however, resulted in unacceptable levels of congestion, aesthetic deterioration, demand for land spaces, and air pollution. Petroleum burning vehicles are estimated to be the cause of from 10 to 60 percent of man-made air pollution depending on whether the basis for the estimate is mass emissions or toxicity of the emissions (15).

The conflict between the desirable features of the automobile and its undesirable concomitant by-products, has recently attracted a significant interest in de-emphasizing its total role in the nation's urban transportation system in favor of a more balanced one.

In addition to the behavioral and institutional aspects of such a shift in emphasis which are discussed in Chapter III, a major national commitment has been made to the development of new technological alternatives. The new awareness of the necessity for environmental protection, resource conservation, safety, and the equitable distribution of wealth and opportunity has injected a new set of ethical values into priorities for research, development, and demonstration efforts in the transportation sector. A variety of old propulsion and levitation systems are being revived, while innovative and imaginative solutions are being experimented with simultaneously.

This chapter reviews a number of recent and current developments in the field. The first six sections deal with the private automobile, bicycles, bus-based transportation systems, variations of railway systems, personal and group rapid transit (PRT/GRT) and dual-mode systems, and vertical takeoff and landing (VTOL) aircraft. The next sections of this chapter discuss alternative guidway systems, and compare the cost and energy consumption characteristics of the different technologies. A final section discusses the potential for combining the desirable features of these diverse systems into a unified composite system.

"It's too ridiculous!" cried Alice, losing all her patience this time. "You- ought to have a wooden horse on wheels, that you ought!"

"Does that kind go smoothly?" the Knight asked in a tone of great interest, clasping his arms 'round the horse's neck as he spoke, just in time to save himself from tumbling off again.

"Much more smoothly than a live horse," Alice said, with a little scream of laughter, in spite of all she could do to prevent it.

"I'll get one," the Knight said thoughtfully to himself. "One or two—several."

—Lewis Carroll

The Automobile

Introduction

Whatever sociological factors are at work in the rapidly shifting character of our

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Metropolitan scene, certainly the availability of the automobile and a rapidly expanding highway system are playing a major role in the transition. During the past decade urban metropolitan regions, particularly those located on the seaboards, have grown significantly both in population and in physical size. Recent forecasts indicate that while the proportion of the population living in metropolitan areas will continue to grow, the residents there will become increasingly less crowded. In 1920, there were 6,580 people per square mile in metropolitan areas; in 1960, the number dropped to 4,230; and by 2000 the estimated density decreases to 3,720. The lower densities clearly illustrate the increasing physical extent of the metropolitan areas, particularly the growth of suburbia (44).

A forecast by the Tri-State Transportation Commission (37) for residents of the New York-New Jersey-Connecticut metropolitan region stated that to handle the expected population growth "without undue congestion" would require adding **each year** "700 miles of local streets, 150 miles of upgraded arterial roads and 70 miles of limited-access highways." Furthermore, a report on transportation problems in the Northeast Corridor, prepared for the Department of Transportation (DOT), predicted the continuing dominance of the automobile, particularly for short business trips and family travel (34). No matter how one views the automobile's role in our society, one fact seems certain: our children will be viewing a lot more of them. And whatever one's feelings may be concerning the accomplishments of the "Highway Lobby," this juggernaut not only continues to roll along but appears to be accelerating.

The Bureau of Public Roads recently released figures indicating a 20 percent increase in the number of Federal-aid highway and bridge construction contracts granted in 1969 as compared with the previous year. The dollar amount of these contracts, namely $5.1 billion, represented a 42 percent increase over 1968. This expenditure shows a certain level of restraint on the part of the Federal Highway Administration since "the highway trust fund is generating more than $5 billion a year and currently contains a $3 billion surplus (35). How long the trust fund will survive, or in what form, is now being hotly debated. In any case, it appears certain many more miles of roads will be constructed if for no other reason than to accommodate all the new cars and trucks to be built in coming years. There are approximately 108 million motor vehicles in the United States today and by 1980 DOT estimates there will be 134 million. According to DOT's annual estimate, these vehicles traveled 1.071 billion miles on our highways in 1969, a 5.4 percent increase over 1968. Approximately half these miles are driven in urban areas, 50.9 percent in 1969 and 50.3 percent in 1968 (48).

Current research and development programs on automotive propulsion systems have concentrated primarily on two major areas: first, **reducing the emissions of the standard Otto-cycle engine** by (a) exhaust gas treatment; (b) modifying the Otto cycle itself; or, (c) modifying the combustion chamber configuration; and, second, seeking **acceptable replacement systems** such as (a) other internal combustion engines; e.g., advanced diesel engines and rotary or "Wankel" configurations; (b) various external combustion engines such as the steam and organic Rankine engines, gas turbine (Brayton cycle) engine, and the Stirling cycle; and, (c) electric drives. Two other areas, however, which perhaps are equally as basic and yet have not been rigorously addressed are the **significant difference** between peak-power demand and power levels required during vehicle cruise and the **economical use of fuel**. The latter is known more specifically as the improvement of automotive energy conversion and utilization efficiency by (a) reducing vehicle weight and drag (both coulombic and aerodynamic, treated in a later section) and (b) providing the capability of rapid and efficient regeneration and storage of vehicular kinetic energy normally dissipated in braking.

The following sections will discuss automobile propulsion systems and emissions, power requirements, hybrid vehicles, and energy storage. A concluding section will describe the path to be charted for the future of automobile technology.

Emissions and Propulsion

Although the United States has committed itself to cleaning up the internal combustion engine rather than to developing new technologies, society has since been informed by the automobile manufacturers that there is not enough time to overcome the technical problems presented by pollution control devices. Consequently, the deadlines for automobile exhaust emissions standards have been extended (see Table II-I) and the prospect for future extension is almost certain (32, p. 18).

To understand the modifications required to reduce the emissions of the standard internal combustion engine (ICE), a basic understanding of the fundamental parameter of the ICE

TABLE II-I

AUTOMOBILE EXHAUST EMISSIONS STANDARDS
(in grams per mile)

	1972	1973	1974	1975 Original	1975 Interim	1976 Original	1976 Interim	1977
Hydro-carbons								
federal	3.4	3.4	3.4	0.41	1.5	0.41	0.41	0 41
Calif.	3.4	3.4	3.4	1.00	0.9	0.41	Carbon	monoxide
Carbon monoxide								
federal	39.0	39.0	39.0	3.4	15.0	3.4	3 4	3.4
Calif.	39.0	39.0	39.0	24.0	9.0	3.4	Nitrogen	oxides
Nitrogen oxides								
federal	—	3.0	3.0	3.0	3 1	0.4	2.0	0.4
Calif.	3.2	3.2	2.0	1.5	2.0	0.4		

combustion process, i.e., the air/fuel ration (A/F), and the alternatives available, catalytic reduction and/or oxidation, is necessary. In the ideal Otto-cycle, the theoretical maximum efficiency is a function of the compression ratio only, and is independent of A/F. However, on the basis of the ideal air-fuel cycle the A/F has an effect on thermal efficiency, which increases as A/F increases. The specific fuel consumption decreases as A/F increases resulting in improved fuel economy. The emissions associated with the Otto-cycle engine are qualitatively shown in Figure 2-1 as a function of A/F. The emissions of HydroCarbons (HC) and Carbon Monoxide (CO) decrease as the A/F is increased while the oxides of Nitrogen (NO_x) emissions peak just above the stoichiometric point (the point at which precisely enough oxygen is present to completely combust all of the fuel to H_2O and CO_2). The baseline Otto-cycle is operated stoichiometrically and although a substantial reduction in HC, CO, and NO_x) emission levels would be achieved by further increasing the A/F, such operation would have serious deleterious effects on vehicle performance and overall drivability. As a result, the emission control technique most actively pursued by the automobile manufacturers has been the catalytic treatment of exhaust gas coupled with exhaust gas recirculation (EGR).

An example of combustion chamber modification is the stratified charge engine. Because of the manner in which fuel is admitted to the combustion chamber, the mixture in a small volume around the spark plug is much richer than the main air-fuel supply. Upon ignition, this rich volume readily ignites and it, in turn, ignites the main air-fuel mixture which is much leaner. More than one method is used to attain stratification of the air-fuel mixture within the combustion chamber. In an engine developed by Texaco, stratification is achieved by creating an inlet-air vortex. Combustion occurs near the end of the compression stroke when fuel is injected into the cylinder and immediately ignited by the spark plug. This ignition occurs in a fuel-rich mixture near the spark plug resulting in a stationary flame front. Additional fuel is injected, mixed with the air, is ignited, and enters the flame front. The excess of oxygen in the cylinder insures more complete combustion than that of carbureted homogeneous air-fuel mixtures resulting in decreased levels of CO and HC. The Honda stratified-charge engine which passed the 1975 EPA emissions requirements, has dual carburetion for a rich and lean mixture in each cylinder. Thus each cylinder has two intake valves and one exhaust valve. The rich mixture is introduced through its own valve in close proximity to the spark plug while the lean mixture enters the main cylinder valve. That is, the air-fuel charge is stratified mechanically rather than fluid dynamically.

As for propulsion systems, in the past decade, efforts to develop acceptable replace-

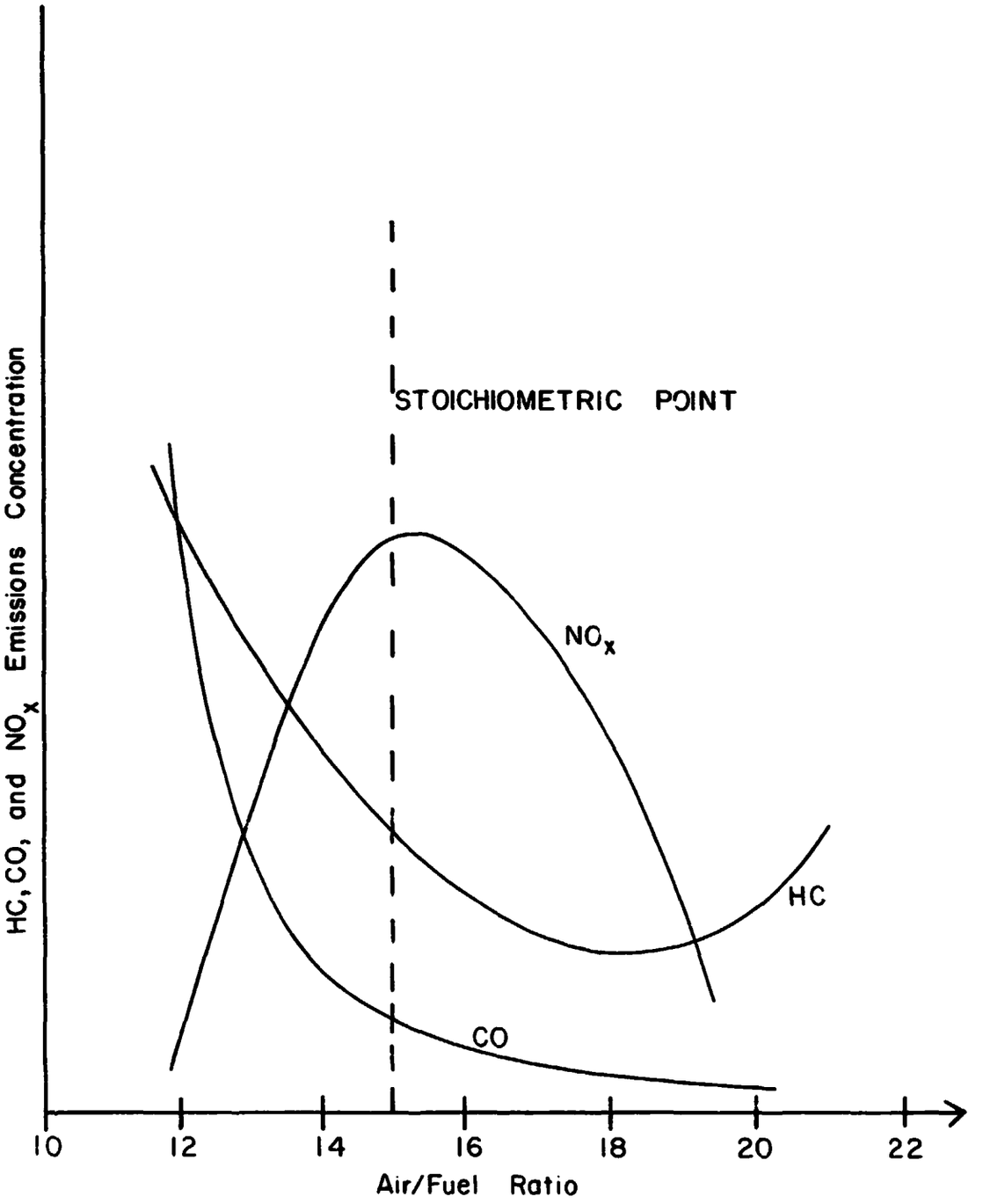


FIGURE 2-1
EFFECT OF AIR/FUEL RATIO (A/F) ON
HC, CO, AND NO_x EMISSIONS

ment systems have been enormous in number. Such advanced automotive propulsion systems are customarily divided into two groups: combustion-type and non-combustion type. The combustion-type prime movers are categorized as either internal or external combustion systems. Included in the former are the fuel injected Otto-cycle engine, the diesel, and the Wankel rotary configuration engine, while the steam engine (Rankine cycle), gas turbine (Brayton cycle) and Stirling engine make up the external-combustion category. As for non-combustion systems, these include all-electric and flywheel driven vehicles. A detailed description of these systems and others including the relative characteristics, merits and limitations of each, as well as future potential, has been treated extensively in the literature and well beyond the scope of this report (1).

Automobile Power Requirements

The power required to propel an automobile can be broken down into **three main** components: (1) power required to overcome the rolling friction of the tires on the pavement; (2) power required to overcome aerodynamic drag forces; and, (3) power losses in the drive train between the engine and the rear wheels.

The power required to overcome tire rolling friction is illustrated in Figure 2-2 for several vehicle weights. One can note that the required power increases directly as the weight increases. The curves also vary somewhat with tire inflation pressure—high tire pressures, although causing a somewhat harsher ride, serve to reduce the power requirements; low tire pressures, of course, have the opposite effect.

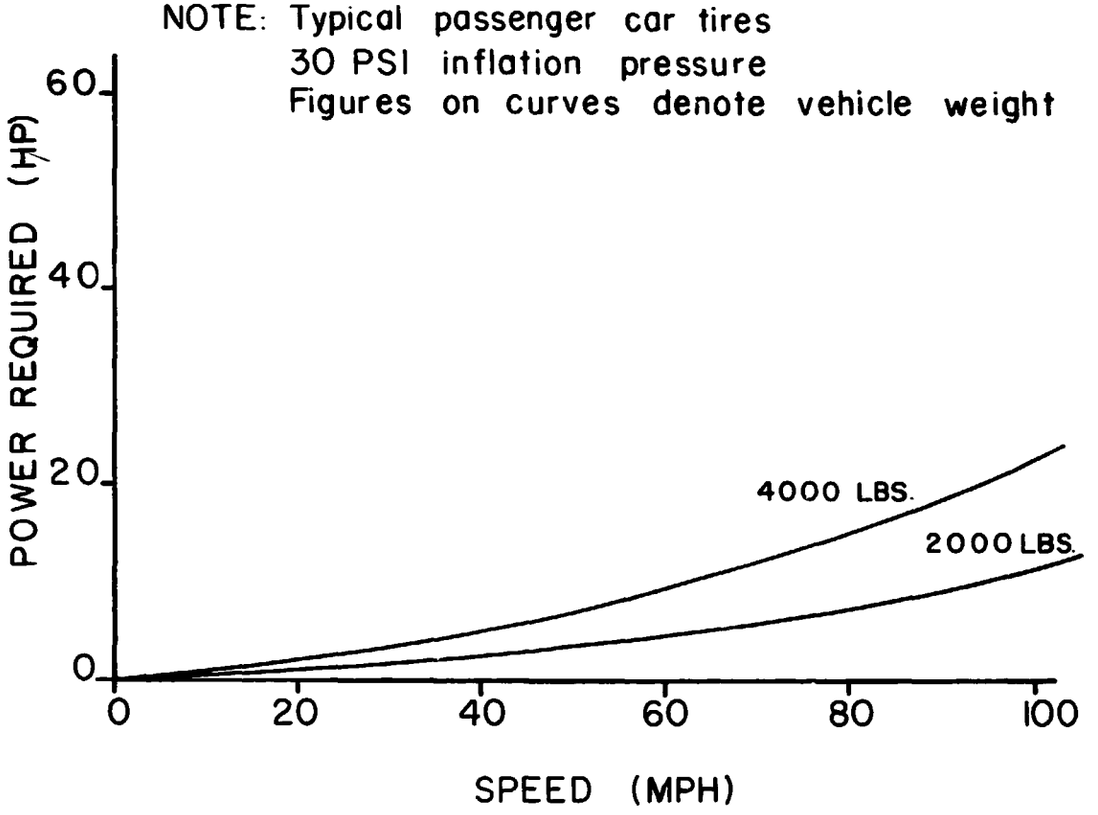


FIGURE 2-2
HORSEPOWER REQUIRED TO OVERCOME ROLLING FRICTION

The power required to overcome aerodynamic drag is not directly a function of weight, but is related to weight through the size of the car. It is also a function of the degree of streamlining of the vehicle. Figure 2-3 shows the variation in power required with velocity as a function of vehicle streamlining and size. For a given forward speed, the power required to overcome aerodynamic drag varies considerably depending on vehicle streamlining and size. Comparison of Figures 2-2 and 2-3 shows that tire rolling friction is larger than aerodynamic drag at speeds below approximately 40 mph, while aerodynamic drag is more important at speeds above this value. Thus, for vehicles designed to operate mainly in an intraurban driving situation, keeping the weight down should be a primary objective. For high speed intercity driving, the prime objective in reducing the power requirements should be to have an aerodynamically designed vehicle of small physical size.

The power losses occuring in the drive system vary greatly with such factors as gearing, standard or automatic transmission, and number of bearings in drive train. The type of transmission has probably the single greatest effect. A reasonable average power loss at design conditions is probably 20 percent of the engine power. Therefore, the engine power required for operation at a constant speed is approximately 20 percent higher than that required at the rear wheels to overcome tire friction and aerodynamic drag.

The total engine power required for constant speed operation is the sum of the power requirements from Figures 2-2 and 2-3 plus approximately 20 percent for transmission system losses. Figure 2-4 illustrates the combination of these power requirements for various vehicle configurations These values of power required are considerably less than the rated horsepowers of today's automobile engines because the size of automobile engines are now determined by acceleration requirements rather than by power requirements for cruise at a constant speed. Thus, typical engines end up being sized about five times more powerful than would be required for steady operation, resulting in the engine being less efficient at rpms significantly different from the design rpm This fact is the basis for design concepts such as the hybrid vehicle to be discussed in a later section.

To estimate the effects shown in Figure 2-4 on the fuel consumption of an automobile engine, consider the fact that the average conventional, 4-cycle internal combustion engine requires a minimum of 0.5 lbs. fuel per hour per engine horsepower, if operating at the designed rpm. Thus, as the required power increases, the fuel consumption also increases. Another way of saying it is that the gasoline mileage (miles per gallon) decreases as the speed, or vehicle size and weight increases.

Application of typical fuel consumption values to the power curves of Figure 2-4 would give mileage curves approximately as shown in Figure 2-5.

In summary, the figures presented clearly show the dependence of fuel consumption on automobile size. Limiting the size of future automobiles can go a long way toward reducing the total fuel consumed by the automobile in the transportation sector of our country.

Hybrid Propulsion Systems

To cruise at freeway speeds requires very little horsepower, but to accelerate to freeway speeds at a satisfactory rate may require peak-power outputs exceeding cruise levels by a factor of three to five. Even in congested urban driving situations, peak-power demand may be quite high when accelerating away from traffic signals, only to be followed by cruise at 30 or 35 mph where power required is miniscule. Although automobile manufacturers are often chided for their use of large engines, not without some reason, the fact remains that the gulf between power required for vehicle acceleration and vehicle cruise is large. Any technique serving to somehow average the power demand would be advantageous since a smaller engine could be used. Replacement of a large internal combustion engine with a smaller external combustion engine with little or no loss in performance would be a significant improvement, but one obviously requiring the use of stored energy.

On-board energy storage, or more broadly the conservation of vehicular energy, is directly related to the problem of efficient fuel utilization The problem of fuel economy has not received appreciable attention from either the technological community or from the consumer; and as a result of many contributing factors, a gross measure of automotive efficiency, the number of miles driven per gallon of gasoline, has been decreasing monotonically since 1940 until it now stands at less than 13 miles per gallon on a nationwide basis. (47, p. 153) Perhaps the current trend toward smaller automobiles will reverse this tendency, but possible gains likely will be at least partially

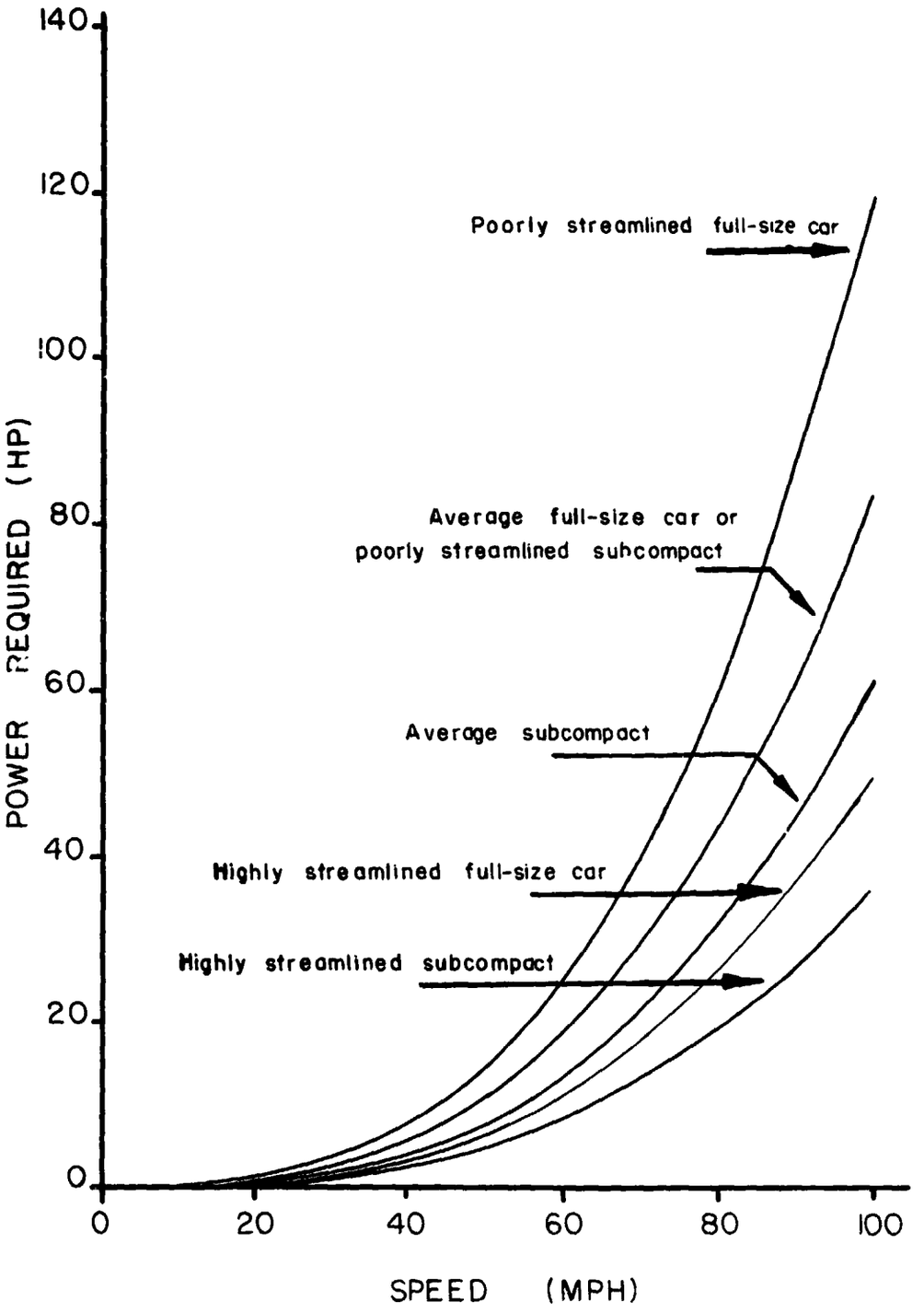


FIGURE 2-3
HORSEPOWER REQUIRED TO
OVERCOME AERODYNAMIC DRAG

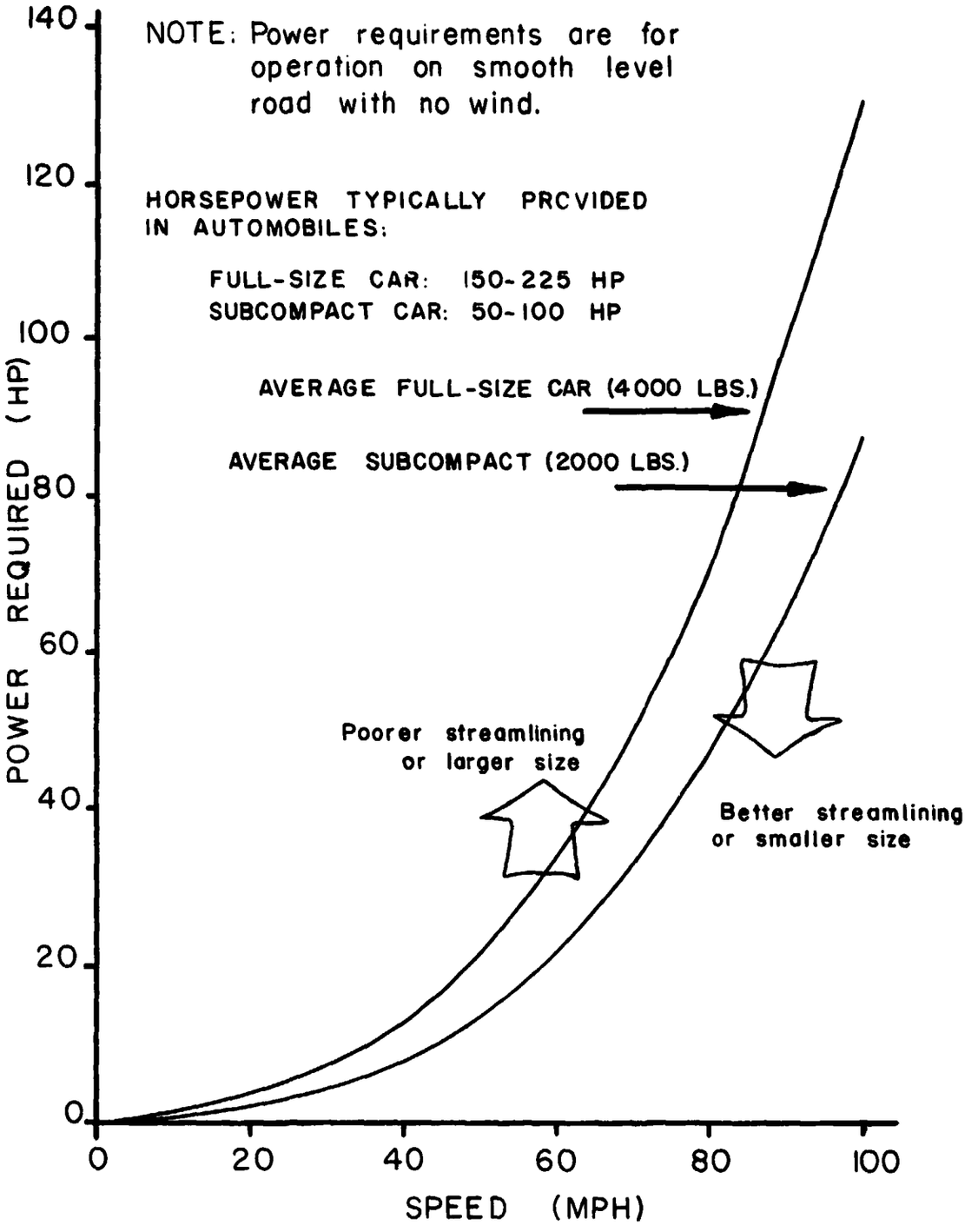


FIGURE 2-4
TOTAL POWER REQUIRED
FROM AUTOMOBILE ENGINE

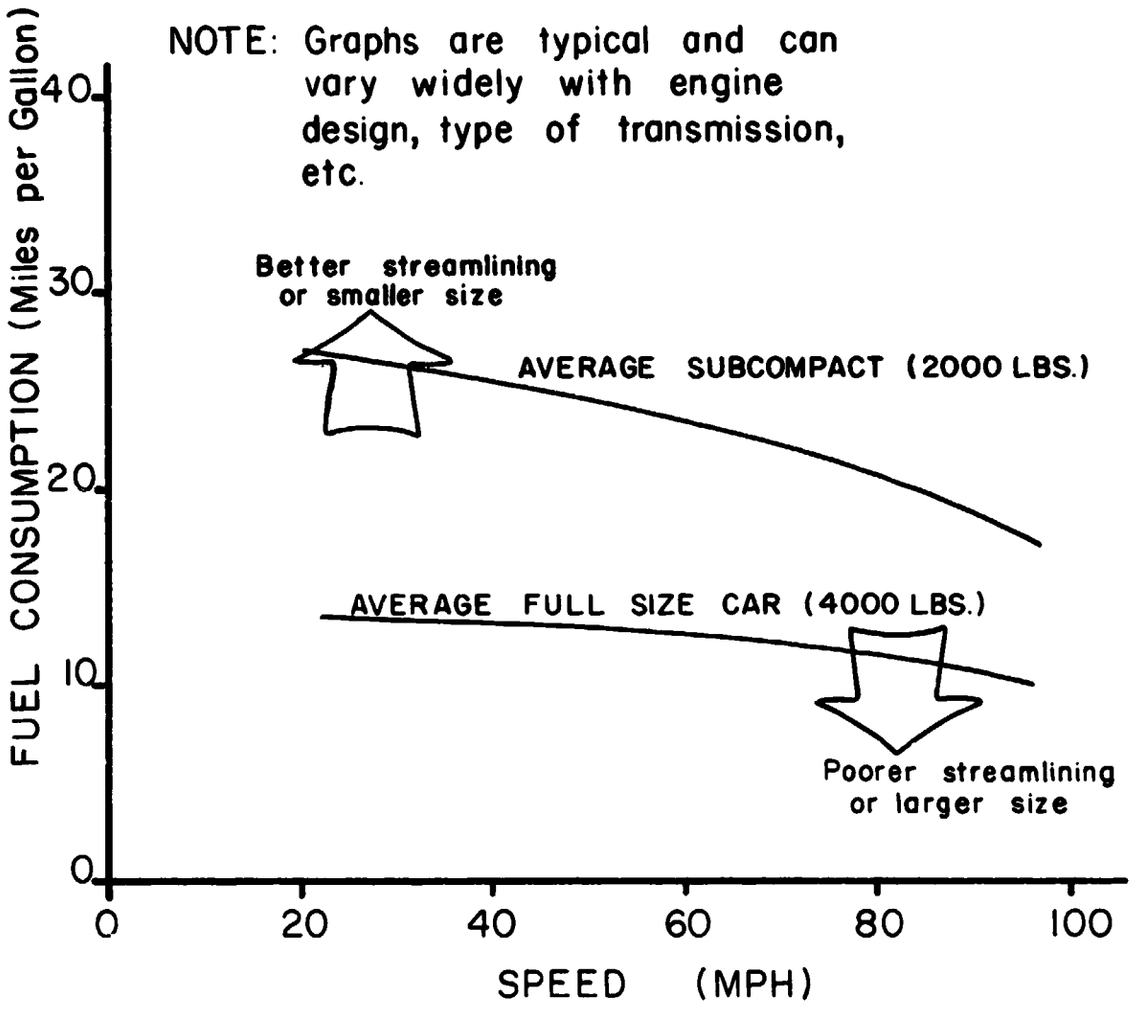


FIGURE 2-5
FUEL CONSUMPTION FOR REPRESENTATIVE AUTOMOBILE CONFIGURATIONS

nullified by emissions control measure, many of which tend to degrade fuel economy.

Another factor bearing adversely upon fuel economy, as well as engine emissions, is the type of driving cycle encountered by those who live in sprawling urban-suburban complexes. These cycles frequently consist of a high-speed segment on a freeway, complemented at one or both ends by a series of start-stop segments of limited duration and low speed. Current trends strongly suggest that this type of driving will become even more common as the metropolitan complexes continue to grow at a rapid pace. The type of vehicle meeting all of these requirements to some degree would be a modest sized (2500 to 3000 lb. weight class) automobile powered by a hybrid propulsion system Very briefly, the design philosophy is to store on board the vehicle a relatively modest amount (400 hp-sec) of energy capable of (1) rapid and efficient recycling to meet high torque and high peak-power demand, and (2) highly efficient regenerative braking such that much of the kinetic energy normally dissipated

in the brake linings can be reused in subsequent vehicle acceleration. Consequently the system is a hybrid, but not in the usual sense. To illustrate, let P denote the power of the vehicle prime-mover and E the amount of on-board energy storage capatiey. Then we categorize various types of design concepts on a plot of P versus E as shown in Figure 2-6

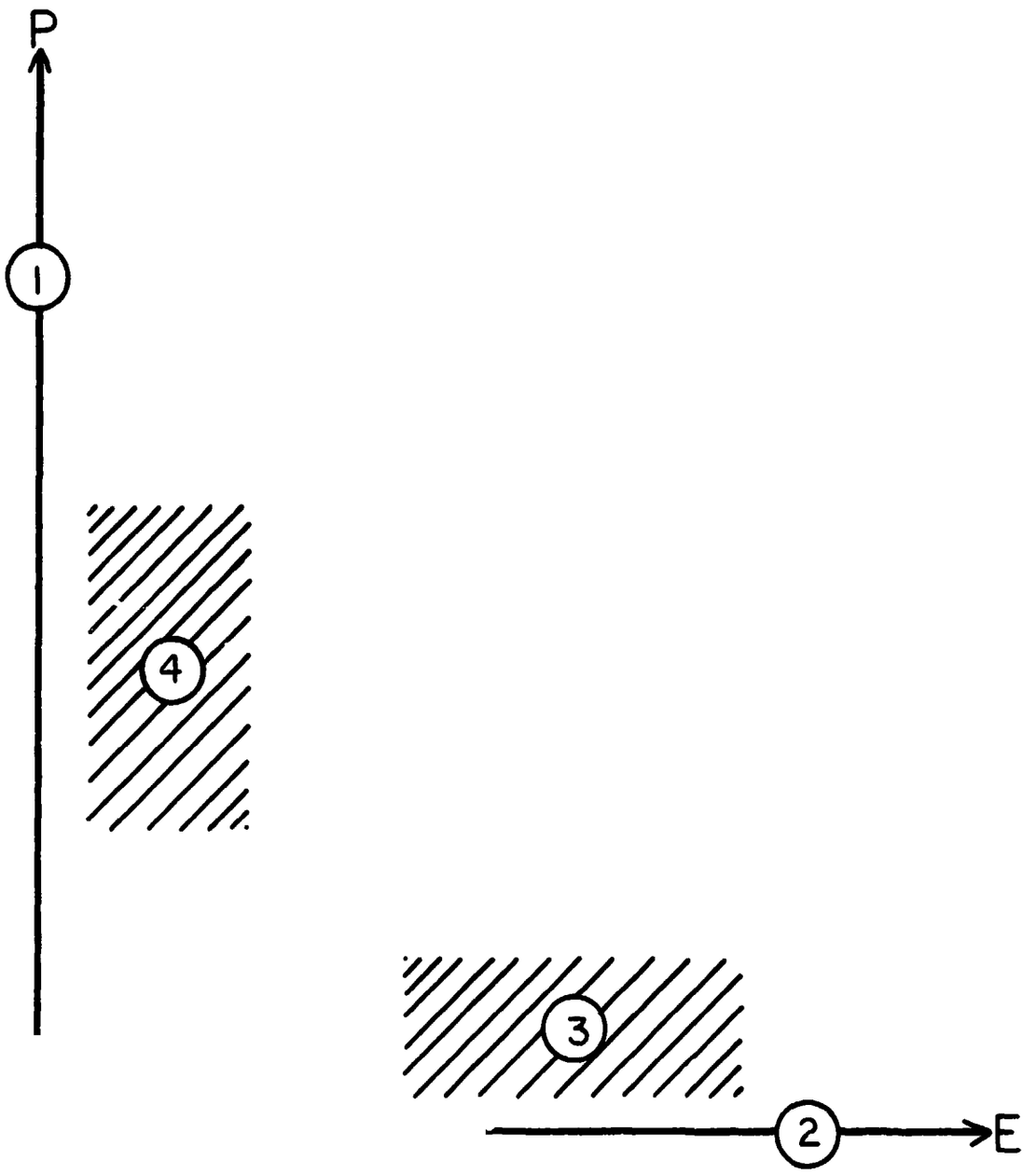


FIGURE 2-6
PRIME-MOVER POWER
versus
ENERGY STORAGE CAPACITY

The point labeled ① denotes the conventional design having no stored energy while point ② might represent an electric automobile relying entirely upon storage batteries. The general area specified by ③ is the usual hybrid, having a small prime mover running more or less continuously to "top off" the primary energy storage system. The general area of point ④ represents a small energy storage capacity along with a medium sized prime mover.

Hybrid designs are customarily divided into two categories, series and parallel. In the series system shown in Figure 2-7 all of the prime-mover power is converted into electrical, mechanical or hydraulic power which is then used either for storage (in a battery, flywheel, or hydraulic accumulator) or for driving the wheels, depending upon the instantaneous vehicle power demand. That is, if the power demand exceeds the capability of the prime-mover, excess power is drawn from the storage device. Otherwise, part of the prime-mover power is used to "top off" the storage system.

In the parallel system shown in Figure 2-8 a conventional transmission is used to drive the vehicle mechanically in the usual fashion. The stored energy system provides power in parallel with the prime-mover, and only a small portion of the prime-mover is tapped to charge the storage system.

Energy Storage

The amount of energy that is stored aboard the vehicle depends of course on the particular "hybrid" concept followed. Whatever this strategy, the energy storage device must meet certain design criteria; it must have the capacity to:

(1) store on-board the vehicle enough energy to meet the time and/or distance requirements as determined by the particular hybrid philosophy chosen. For example, in the hybrid concept specified by ④ only a small amount of energy would be required to negotiate a single acceleration;

(2) provide the capability of rapid and efficient energy recycling (both in acceleration and deceleration) to meet the high torque and high peak-power demands typically encountered in urban driving situations. The parameter of interest here is the **power density**, the **rate** at which energy can be extracted or put in, per unit weight of system;

(3) provide highly efficient regenerative braking such that much of the vehicle's kinetic energy normally dissipated in braking can be reused in subsequent acceleration; and,

(4) repeat the charge-discharge cycle more or less indefinitely.

The near-term available methods of sharing energy for mobile and applications and a comparison of the energy density, power density, and cycle life (19) is given in Table II-II.

A detailed analysis of the third criterion (given in Appendix F) shows that the energy normally wasted as heat in the brake linings during the deceleration segments of a typical driving cycle is well worth saving for subsequent reuse, at least in principle. Whether it is worth saving in practice depends upon who efficiently the energy can be recovered, stored, and reapplied to the wheels, all of which will be considered later.

Conclusions

While one cannot accurately predict what the future holds for the automobile and urban ground transportation, one fact is certain:

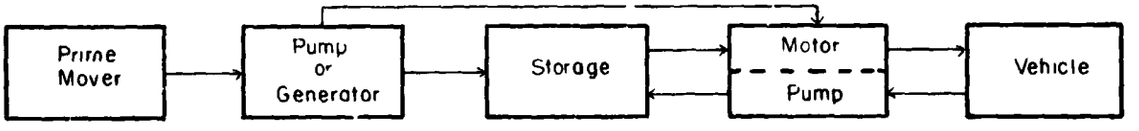


FIGURE 2-7
HYBRID PROPULSION SYSTEM: SERIES CONFIGURATION

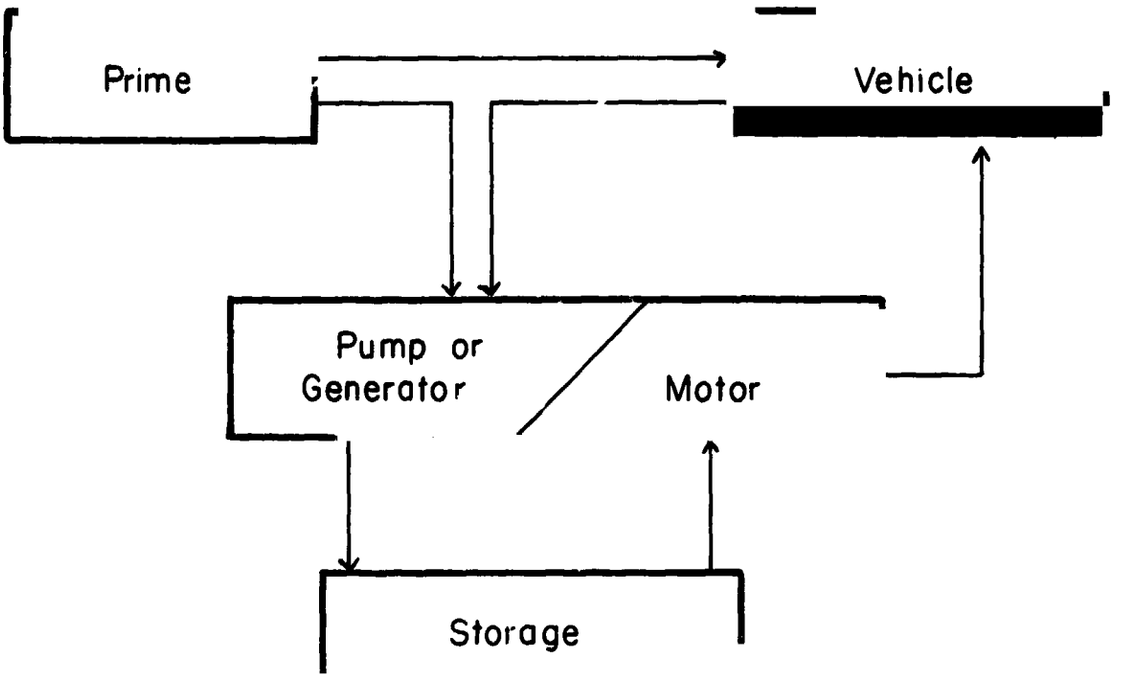


FIGURE 2-8
HYBRID PROPULSION SYSTEM:
PARALLEL CONFIGURATION

transportation is at the threshold of an era marked by (1) a continuously greater emphasis on moving and accomodating **people** rather than vehicles, and (2) the development of energy-efficient vehicles and transportation systems or more correctly, the optimal matching of the vehicle or transportation mode to the corresponding need.

Another trent no less apparent, is the continued physical expansion of urban metropolitan regions as well as the corresponding decrease in urban population density which is expected to be halved in the 100-year span of the present century. With well over a third of the population in the United States now living in suburbia and with a forecast of one-half living there by 1985, it is difficult to imagine how the present and persistent reliance on the automobile might be diminished or even substituted by some other mechanism or system.

When these two trends—(1) accomodating people rather than vehicles, and (2) sprawling metropolitan areas with decreasing population densities—are juxtaposed, the result is an apparent impasse. To imagine how such a problem might be resolved is even more difficult.

Whatever the "vehicle of the future" may be, the ratio of automobiles to people is not going to level off as many have suggested. As Doxiadis wrote,

> We must ask ourselves whether we do not need more vehicles; even perhaps, as I believe, one automobile for every citizen young or old, poor or rich. If so, we must specify the city and the automobile accordingly. Only then will the goals define our further actions (3, pp. 51-54).

What is needed in the way of the automobile is a much improved version of what presently exists; an automobile designed to operate with (1) acceptable performance and comfort on today's inner and outer loops, and tomorrow's way-outer loops, as well as (2) efficient (energy-wise) and nearly emissions-free capability in the start-stop-wait situation encountered in the city proper. It must have a range of several hundred miles and be at least

as reliable and safe as present models. So as not to preclude carpools in the commuting situation, and family use on shopping and pleasure excursions, the automobile must be of reasonable size and capacity. Finally, its cost must not substantially exceed our present expectations. Such a vehicle would be: (1) of the 2,500 to 3,000 lb. weight class; (2) aerodynamically streamlined (including the proper frontal design and undercovering) with a combined drag coefficient-projected area (CDA) equal to 5 or 6 rather than 10 or 12; (3) capable of seating up to 5 or 6 total passengers or handling a sufficient amount of cargo as is only occasionally required by the majority of automobile owners; and, (4) powered by an energy-efficient, regenerative hybrid propulsion system with both steady-state, prime-mover-direct-drive capability and a modest-sized energy storage capacity that would augment prime-mover power during peak-power conditions and/or as desired within the urban area.

Buses and Bus-Based Systems

For more than a century, the bus has been used to transport people in urban areas. Long experience with variations on this mode have generated a vast amount of information on its uses; however, it has also suffered from the well-known problem of contempt which comes with familiarity. The city bus today is little changed from the first one and with the possible exception of air conditioning, there is little attractive difference between the 1974 bus and

TABLE II-II
ENERGY STORAGE TECHNOLOGY

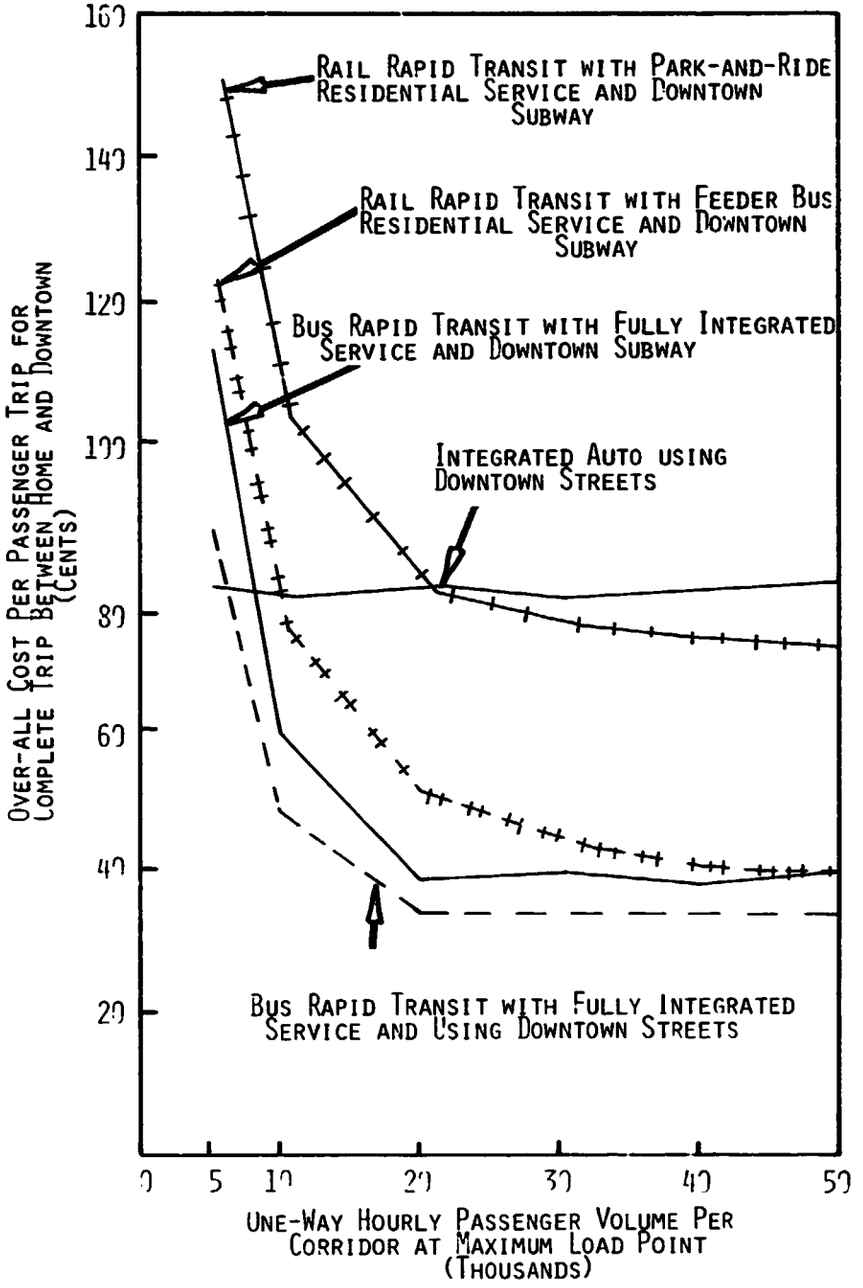
Storage System	Energy Density Wh/lb	Power Density W/lb	Deep (75%) Discharge Cycle Life, Cycle
Electrochemical Storage			
Lead-Acid Batteries	8.1	36	300-500
Nickel-Cadmium Batteries	13.9	36	1000-3000
Kinetic Energy (Flywheels)			
Oerliken Electrogyro	2.7	150	10^5
Maraging Steel	25.2	10^4	10^5
4340 Steel	15.1	10^4	10^5
John Hopkins Univ.	30	10^4	10^5
Deformable Solid Bodies			
Steel Spring	.04	10^4	10^7
Natural Rubber Band	4.0	36	1000-5000
Compressed Gas	3.5	10^4	10^7

the 1947 bus. In fact, in most cases, the changes which have occurred probably have been negative—one is apt to be riding the very same vehicle today as he would have ridden in 1947.

For many people, the technology of the modern city bus is not exciting and its appearance and ride are not pleasing. Why, then, should there be concern about examining it technologically in order to ameliorate urban transportation problems? How can the notion that it is important be justified when there are so many innovations such as PRT, monorails, subways, and VTOL aircraft?

The answer is that the bus is important because usually it is the most **practical** alternative to the private automobile. In their famous study of urban transportation in the 1960's, Meyer, Kain, and Wohl presented a graphic illustration of why buses should be used in urban public transit systems (4). This graph (Figure 2-9) relates the cost per passenger trip to the volume of passengers on the corridor. Over the range of density presented here the bus dominates the cost comparison with rail systems and automobiles. Note that the curves for bus rapid transit using downtown streets is below the cost curves for other modes. This implies that buses provide trips at the lowest cost when corridor volume is below 50,000 passengers per hour. Meyer, Kain, and Wohl went on to point out that in their judgment only a few American cities like New York and Chicago had corridors with sufficient volume to make rail systems advantageous, and these cities already had such systems. While this study is now ten years old, there has been little evidence to contradict these conclusions. Moreover, recent innovative alternatives suggested for mass transit probably will not displace the lowly bus from its lowest cost position in areas where use density is not exceptionally high. In light of these facts, there seems to be justification for federal policy which favors bus acquistion over the construction of newer technology which is much more exciting.

Accepting the contention that buses are an efficient way of moving people should not lead us to accept the status quo. There are exciting new developments in bus transit systems, although most of them are related to the **system** in which the bus is used **rather** than the bus it-



REF: Meyer, J.R., J.F. Kain and M. Wohl, The Urban Transportation Problem. Cambridge, Mass., Harvard University Press, 1965

FIGURE 2-9
COMPARATIVE COSTS OF PASSENGER TRANSPORTATION

self. The benefits and costs of bus mass transit systems are greatly dependent upon how the vehicle is utilized. Of course, this specific utilization will have some feedback effects on the design of this mode which is most efficient.

As a first step in examining bus systems, one can examine the nature of the vehicle itself. Major characteristics of buses are their capacity for carrying from six to sixty or more passengers, their use of the public roads; and, their variety of propulsion systems, with diesel and gasoline engines predominating. The costs of the vehicles themselves range from less than $10,000 to more than $50,000 with most falling within that range depending upon size and equipment. These costs should be considered in the light of the longevity of buses, since large, initially expensive buses have been known to give millions of miles of service over decades of use. On the other hand, some of the smaller vehicles have been referred to as "throw-away buses" because their design life is so short.

Stretched-cab limousines seen at airports should also be included under this definition of buses. Since conventional taxis are designed for individualized, rather than mass, service they are not included here.

The initial cost of the bus is only a minor element of the total cost. Indeed, one of its advantages for low density areas is the low capital cost required. One may want also to consider garages and some portion of the costs of roads and traffic control facilities to get a fair comparison with other modes. However, there would still be a tendency for costs per hour or costs per trip to be dominated by the operating costs, which will vary somewhat depending upon the type of system. In most cases the bulk of the operating costs will be labor costs which vary little with the type of system (27, p. 13). If one very carefully controls the parameters of the system, then comparison might be made on a cost per mile or cost per hour basis for buses and other modes. Figure 2-9 represents such a comparison. However, these costs will differ from city to city and will be particularly sensitive to prevailing wage rates for drivers of the buses.

While labor seems to be the most important quantitative source of cost, current interest in energy efficiency warrants at least some discussion with respect to the use of petroleum and other fossil based resources by buses. An examination of Table II-III shows that various sized buses look favorable from a purely energy-comsumptive perspective. Rush-hour buses yield 84 passenger-miles per gallon compared to 9.1 passenger-miles per gallon for the standard urban commuting auto. Even off-peak buses with only twelve passengers yield 40 passenger-miles per gallon.

Here again one must be cautious about "typical" figures, but the range of difference in the figures indicates that one can safely say that bus transportation can move more people using less petroleum. In addition, the energy saving, accomplished by a reduction in pollution per passenger mile, is another desirable feature for transportation modes of the future. Studies of hybrid vehicles suggest that city buses are operated in such a way that energy storage innovations are particularly effective. Hence, future developments may make a hybrid bus even more energy-efficient than current models. A discussion of energy collection and storage techniques and their prospects can be found in Appendix F.

Having discussed the characteristics of the bus in very general terms, the next step is to examine various systems in which it might be used. Flexibility is a useful means of differentiating types of service, since it is important both for ridership and unit costs of operation. While there are alternative approaches, this discussion will focus on the following types of service: (1) fixed route; (2) subscription; (3) route deviation; and, (4) dial-a-ride.

Fixed route service is the conventional system of laying out a path to be followed repeatedly with stops along the way to pick up and discharge passengers. **Subscription** service is very similar to fixed route, but the precise route is determined by standing individual orders to go from one point (e.g., home) to another (e.g., work) at a specific time of the day and week. While fixed routes are impersonal attempts to serve groups of random riders, subscription service is designed for particular individuals who have committed themselves to be patroms. **Route deviation**, like subscription, is an attempt to be more responsive to users by leaving the established route to pick them up at the door of their origin or destination when it is with a prescribed distance. **Dial-a-ride** is even more flexible because time of departure is determined by the rider; he is picked up at his location and discharged at the door of his destination.

As one goes down the list of types of service, he can see that they involve increasing flexibility to fit the needs and desires of passengers with respect to time and space. Perhaps the next step is toward individualized taxi ser-

TABLE II-III
ENERGY EFFICIENCY OF HIGHWAY VEHICLES

Vehicle	Passengers	Passenger Mile/Gallon	Speed
Rush Hour Bus	42	84.0	20
Off Peak Bus	12	40.0	25
Microbus	5	89.0	40
Limousine	10	50.0	50
Small VW	1	25.0	25
Standard Auto	1	9.1	30
Heavy Auto	1	8.1	30

Ref: Rice, Richard A., "Historical Perspective in Transport System Development," Proceedings of the Transportation Research Institute, Carnegie-Mellon University, 1970.

vice which does not provide for shared rides. Increasing attention to the patron's time schedule and trip patterns increases the desirability of the mode. However, vehicle productivity goes down with increasing flexibility and costs per trip are therefore increased when the trip is made more desirable. If buses and drivers are used to decrease the time and discomfort of the rider, they cannot physically handle as many riders. With fewer riders the costs of the bus and driver will be spread over a smaller number of trips and the cost per trip will be higher.

By looking only at the cost, one might conclude that financially struggling mass transit systems are foolish to offer anything but fixed-route service. Given the same number of passengers, the fixed-route system definitely is going to be the least expensive per passenger mile, yet the number of passengers is not likely to be the same. If the established system requires one to expend significiantly more than twice the time for a trip in a car, he is much less likely to choose public transportation, particularly if much of the delay is at a transit stop, rather than in the comfort of his own home, or at least in a warm, dry structure. Costs per trip of a fixed-route bus will be very high indeed if very few people decide to make their trip by that mode. If increased flexibility and better service encourage greater ridership, then vehicle productivity can go up rather than down and costs per trip can be lower. Moreover, since riders pay fares, there may be financial benefits to incurring the higher costs. So long at the additional costs of prividing flexibility are covered

by additional fares, transit systems should move in this direction, even though their operating deficits will not be completely eliminated.

Whether the innovative, demand-responsive systems will increase revenues enough to justify their costs is a matter open to debate. Karl Guenther, Dial-a-Ride Program Manager of Ford Motor Company, spoke out positively for demand-responsive services. His research and experience with operating systems led him to the following conclusions:

1. The operation of dial-a-ride public transportation service is totally feasible from a technical point of view;
2. The patronage of the public will be at a substantially higher level for the new kind of service than for conventional fixed-route, fixed-schedule service; and,
3. There is a significant diversion of travel to dial-a-ride from the private automobile (17).

Daniel B. Roos, Director of the dial-a-ride project at MIT has maintained that demand-responsive transportation has already proven itself to be justified. He wrote that

> Demand-responsive systems lack much of the glamour of other 'new systems' where significant funding efforts have already been made. However, whereas the technical and economic feasibility and potential transportation role of these other systems is still very questionable, demand-responsive transportation has already demonstrated that it serves important needs (43, p 27).

Pilot projects now underway have indicated achievement of their goals. The Valley Transit District of Derby, Connecticut, has experimented with a flexible transit system including dial-a-ride and indicated in their interim report a successful demonstration of feasibility and a need to expand the size of their fleet (23). Transportation of the Elderly (TOTE), a project in St. Petersburg, Florida, uses door-to-door service along with other flexibility innovations and has been successful in gaining ridership among the elderly and handicapped (29).

In both of these specific experiments and in other dial-a-ride projects, the ridership did not come quickly, but support was growing steadily. Another system in Ann Arbor, Michigan, has been popular enough to get voters to approve higher property taxes for increased service.

While the fact that the dynamic nature of these systems and their acceptance cannot be adequately represented by a summary table of information from one point in time, the information in Table II-IV shows some of the relevant statistics for seven dial-a-ride systems. Here again, comparisons must be made very cautiously because the objectives of these systems are quite different. Each system serves a rather small area in terms of geography and population. The table shows that some areas have been more successful than others in getting riders. The Canadian communities and Batavia, New York, have been particularly successful in getting relatively high patronage relative to the available population. Some perspective on these ridership figures is given by Roos who pointed to the fact that Regina experienced an 800 percent increase in ridership over a fixed-route system in one of the neighborhoods which changed to telebus. In Bay Ridges, a previous fixed-route system had been discontinued due to lack of ridership, and in Batavia, New York, the ridership has increased 30 percent in spite of a 250 percent fare increase that accompanied the demand-responsive system. Even Columbia, Maryland, which has the lowest riders per weekday should be viewed with the knowledge that demand-responsive service increased patronage 500 percent over the previous system, which was limited to fixed-route service (43, p. 27).

While Table II-IV provides information on some of the successes in getting people to use dial-a-ride, it also points out the area of the concept which is open to severe criticism. Since average trip costs exceed fares, none of the existing systems shown here cover the costs of its operations. All of the projects receive some sort of public subsidy. Even the Canadian systems, which have surpassed the ten passengers per square mile per hour level which Guenther described as the range of "maximum efficiency" (17, p. 81), are still operating at a loss. Such results are especially discouraging for private entrepreneurs, but the publicly-funded systems are also apt to be discontinued if they heavily drain the public purse. The Haddonfield, New Jersey, system has already announced a discontinuation of service (49). Rochester, New York, introduced a Dial-a-Bus system with $1 fares and a goal of breaking even (33); however, recent reports indicate operating costs of $2.40 per trip (49).

TABLE II-IV
DIAL-A-RIDE DATA

City	Area Mi^2	Service Area Population	Avg. Daily Patronage	Avg. Pass/ Vehicle Hour	Avg. Demands/ Mi^2/hour	Avg. Cost Vehicle Hour	Avg. Cost Passenger	Avg. Fare
Ann Arbor, Mich	1.36	10,000	200	6.0	7	$14.60	$1.79	$0.50
Batavia N. Y.	4.75	17,300	340	13.0	6	12.50	.92	0.50
Bay Ridges, Ontario	1.34	13,700	700	17.0	30	8.45	.60	0.25
Columbus, Ohio	2.50	55,000	355	8.4	9	16.06	1.53	0.20
Haddonfield, N. J.	6.50	16,000	730	6.1	4	15.40	2.48	0.50
Regina, Saskatchewan	2.75	18,000	2,000	20.0	21	13.43	.71	0.32

Ref: Guenther, Karl, Ford Motor Company's Role in Dial-a-Ride Development. Demand Responsive Transportation Systems. Special Report 136. Highway Research Board, Washington, D. C., 1973, p. 81 and Daniel Roos, "Doorstep Transit," Environment, Vol. 16, No. 5, June 1974, p.27. (This table is a composite of these two reports).

If transit operations hope to eliminate deficits by installing dial-a-ride, current evidence indicates they will be disappointed. That such systems are not justified does not follow. Before that conclusion can be reached, there are a number of points to be considered. First, these projects are initial steps toward more flexible service which may need time to prove themselves. Habit in modal choice takes time to overcome. Moreover, some of the newer schemes of combining different degrees of flexibility for different periods of the day show a lot of promise, but have not been operating for very long. Insufficient evidence exists on the effects of using vehicles in high volume fixed-route or subscription service during peak hours and then switching to more responsive door-to-door operations in other hours of the day. Additional revenue can also be obtained by chartering the vehicles for group trips. Derby, Connecticut is experimenting with these and other innovations, and there should be a good deal more data available soon.

The flow of information coming from the Derby and other experimental projects causes a second point to be considered. If the goal is to generate information on the technical feasibility of a number of items, then the cost may be rather high. For example, the Derby project is experimenting with computerized fare calculation and collection, special vehicles for handicapped passengers, as well as the basic flexibility concepts. The costs per trip are bound to be higher in experiments than they would be in an operating system without so many prototype features.

Third, all of these projects discussed thus far have been of small scale. There is evidence that significant scale economies may be achieved in larger systems. For example, if the number of vehicles exceeds ten, a computer algorithm begins to be economically feasible. Once these computer scheduling techniques are instituted, efficiency increases dramatically. One study estimated that if system costs were $0.61 to $2.00 per trip with manual dispatching, computerized scheduling could lower costs to between $0.40 and $1.30 per trip (21, pp. 40-59). If demand-responsive service is not attempted at larger scales, it might be incorrectly rejected as a concept of transportation innovation. What would have happened if Henry Ford had decided to test his idea of the Model T with 10 vehicles produced per year until the car looked feasible?

A fourth area of discussion on costs relates to the fact that profitability may be too harsh a criterion for demand-responsive innovations. After all, are the fixed-route, fixed-schedule systems making money? As has been indicated earlier in this discussion, a minimum consideration should be that more flexibility will be introduced so long as the added costs are covered by higher levels of revenue. If this rule is followed, the overall deficit, though still posi-

tive, will be lower as a result of the higher quality service offered to the transit patrons.

Is there evidence to suggest that deficits will be lower? The answer to this question is **yes**. Bay Ridges, Ontario, has provided cost comparisons for its fixed-route and demand-responsive systems (22, p. 45). Similar figures have also become available from the Regina, Saskatchewan, project (8, p. 18). Table II-V presents these data. In one case, the costs of demand-responsive service are lower and in the other the difference is less than 10 percent. At the same time, ridership has increased as much as 500 percent in Regina over the fixed-route system, and riders are using the Bay Ridges system while its previous fixed-route system could not get patronage. Ridership experiences in other cities indicate that revenues are likely to increase enough to cover the slightly higher costs per mile for increased flexibility. For example, Mansfield, Ohio, had an early experience with route deviation which was discontinued, but, at the time it ended, even this small step forward flexibility had improved the financial condition of the route in comparison with the previous fixed route. Moreover, door-to-door service can enhance fixed-route elements of a combination system. By acting as feeder buses or just getting people into public transit again, the demand-responsive system can increase the financial performance of the fixed-route operations as well.

Examination of the evidence suggests that the cost effectiveness of demand-responsive

TABLE II-V
COST OF FIXED AND FLEXIBLE ROUTE SERVICE

	Regina Costs per Revenue Mile		Bay Ridges Costs per Revenue Mile	
	Fixed	Telebus	Fixed	Demand Response
Wages	$0.55	$0.52	$0.33	$0.33
Fuel and Maintenance	0.18	0.18	0.21	0.09
Capital	0.17	0.12	0.07	0.09
Overhead	0.21	0.37	0.28	0.21
	$1.11	$1.19	$0.82	$0.79

Ref: Atkinson, Wallace G., "Telebus Project in Reginan Demand Responsive Systems. Special Report 136. Highway Research Board, Washington, D.C., 1973, p. 18 and Daniel Roos, "Operational Experiences with Demand Responsive Transportation Systems, "Highway Research Record, #397, New Transportation Systems and Technology. Highway Research Board, Washington, D.C., p. 45.

systems may be better than one's initial impression when he looks at fares and costs per trip. The facts tend to support the conclusion that although the flexible systems may not cover costs, they are at lease useful supplements which can lower the deficits of an exclusively fixed-route system. Moreover, as will be pointed out in Chapter III, getting people away from using their cars leads to more efficient use of resources since auto drivers currently do not consider all the costs of their actions. At the same time, expanded mass transit will increase the mobility of people without cars. Furthermore, the operation of demand-responsive systems is providing information which will be useful to designers of future innovations in the transportation field.

Apparently, the efficiency gains from sharing rides, the equity benefits from increasing autoless people's mobility, and the information obtained for future, more efficient transportation systems might together justify significant subsidies to more flexible transit. Quantification of these gains has not taken place sufficiently and always will be difficult to obtain. More support of such systems is needed over longer periods of time to learn how to operate responsive systems efficiently and get better data on just how feasible they can be. Much support is going to much fancier systems which are far in the future and often have some of the disadvantages of existing fixed-route systems. Although the payoffs are hard to measure, demand-responsive systems deserve higher levels of financial and research support, since they have shown themselves to be effective ways of getting at the efficiency and equity goals of urban transportation systems.

Bicycles

Bicycle sales in the United States stand at about 15 million per year, as compared to 11 million cars. The present trend in bicycle sale and use is not new. Improved mass production techniques in the latter part of the 9th century have resulted in a dramatic drop in bicycle prices and in what might be described as the first bicycle boom. Podolski wrote.

> With this, America's first bicycle "craze" was on—and like today, bicycle advocates were clamoring to improve conditions for bicycling. Albert Pope, a prominent bicycle manufacturer of the time, estimated that it cost an astronomical $1.5 billion to feed the nation's horses and mules. He contended that the American farmer would save $700,000,000 annually on fodder if $20 billion were invested in surfaced roads since they would eliminate the need for so much horsepower. His ulterior motive, however, was to improve conditions for bicycling. The League of American Wheelmen took up the cause for better roads with such zeal that after 1900 it changed its name to the American Road Builders Association to assure the best possible combative posture. Joining the League and other bicycle advocates were supporters of the new rich man's toy—the automobile. It is ironic that the successful pioneering efforts of the bicyclists to improve and road surfaces helped spawn, to a large extent, the automobile era. Today, the most serious deterrent to good bicycling conditions is conflict between bicycles and automobiles sharing the same road surface (40, p. 687).

Philip Ableson has written that half of the consumption of gasoline by autos occurs on trips of three miles or less (31). If a large portion of these neighborhood trips were completed by walking or bicycling instead of by car, millions of gallons of gasoline could be saved. If even one tenth of the 3-mile-or-less auto trips were made by bicycle, ten million or more gallons of gasoline would be saved each day (9).

Consider the energy efficiencies of passenger travel methods which show the bicycle to be approximately 40 times more energy efficient than the automobile (46, p. 1):

Means of travel	BTU/passenger mile
bicycling	200
walking	300
buses	3,700
automobiles	7,900

One mile of freeway costs $4,000,000 to construct and one mile of secondary highway costs $500,000 to construct (California 1972 figures); the cost to construct an eight-foot-wide bike path for one mile in Ann Arbor, Michigan was $24,000. It is also estimated that the carrying capacity of a 12-foot cycleway exceeds the capacity of a 24-foot-wide road (40, p. 690). These numbers indicate that bikeways cost only one percent of the cost of freeways and five percent of secondary roads.

Comprehensive bikeway programs have not received the attention they deserve on either a city-wide or regional basis. No signifi-

cant efforts have been undertaken in terms of surveys, safety measures, demonstration projects, research, education, utilization of existing streets and walkways, provision of bicycle paths to and from schools and public transit stations, provision of weather shelters and comfort stations, and promulgation of standards, security measures, and citizen participation in bikeway planning regulations for the registration and use of bicycles. The Bureau of Outdoor recreation has recommended a minimum standard of 50 miles of cycle paths for every 100,000 city dwellers. This amounts to about 75,000 miles of cycle paths throughout the country (40, p. 691).

The street departments of most municipalities have been oblivious of the needs of bicycle riders. Sharp curbs that deform the bike wheels or catch the pedal to destroy the rider's balance, drainage grates that entrap the front wheel, and innumerable discontinuities of design and thoughtless procedure, have made a veritable obstacle course of many neighborhood bike trips.

Sometimes a city cyclist wants to ride the bus and take his bicycle along. There is need to improve the interface between buses and bicycles. A preliminary demonstration has been done hauling the bicycles behind buses on lightweight trailers (14). Since the buses were express buses, the trailers were built with strong standard hitches and the conventional stable two-wheel support. The bike storage racks were rigid enough to protect against acceleration and vibration, designed for quick and easy loading or unloading, and yet universal in their bike application.

The bicycle-bus-trailer system would be expecially useful for carrying cyclists great distances, across long bridges, or over sections of the highway which are dangerous (14). The "bicycle boom" is occurring at a time when pressing environmental problems are being faced. Bicycle riding in the United States should be recognized as a legitimate form of transportation, as in European countries which have demonstrated that bicycles are not only convenient, but in many cases, a preferred form of transportation (42, p. 8).

Railway Systems

Since the middle 1940's, although the overall demand for transportation has been rapidly increasing, the demand for trains has decreased. A major or federal goal is to improve passenger service and increase ridership (5, pp. 11-48).

The Federal Railroad Administration is presently involved with two programs to improve passenger transportation using tracked vehicles. One being the Tracked Levitated Vehicle (TLV) Program, which is discussed under a separate section, and the Improved Passenger Train (IPT) Program. These programs are being funded jointly under the High Speed Ground Transportation Act of 1965 and the Urban Mass Transportation Act of 1964 (as amended) (25). Whereas the TLV Program is a long-term program needing additional research and advance development work before an operating system can be built, the IPT Program is not a research project. It is a low risk development emphasizing quality, reliability and a minimum of track upgrading to provide a superior quality ride. Higher speeds are desired but when the speed exceeds 100 mph or so, the track maintenance costs begin to rise tremendously. To maintain a high quality ride at such speeds it is necessary to either make expensive track improvements or to develop better suspension systems for the passenger cars. The focus is to optimize the trade offs between these methods. The characteristics of trains along with the efforts to improve the passenger train by the Federal Railroad Administration and other organizations can be discussed under three categories, only one of which is applicable to this report: conventional trains.

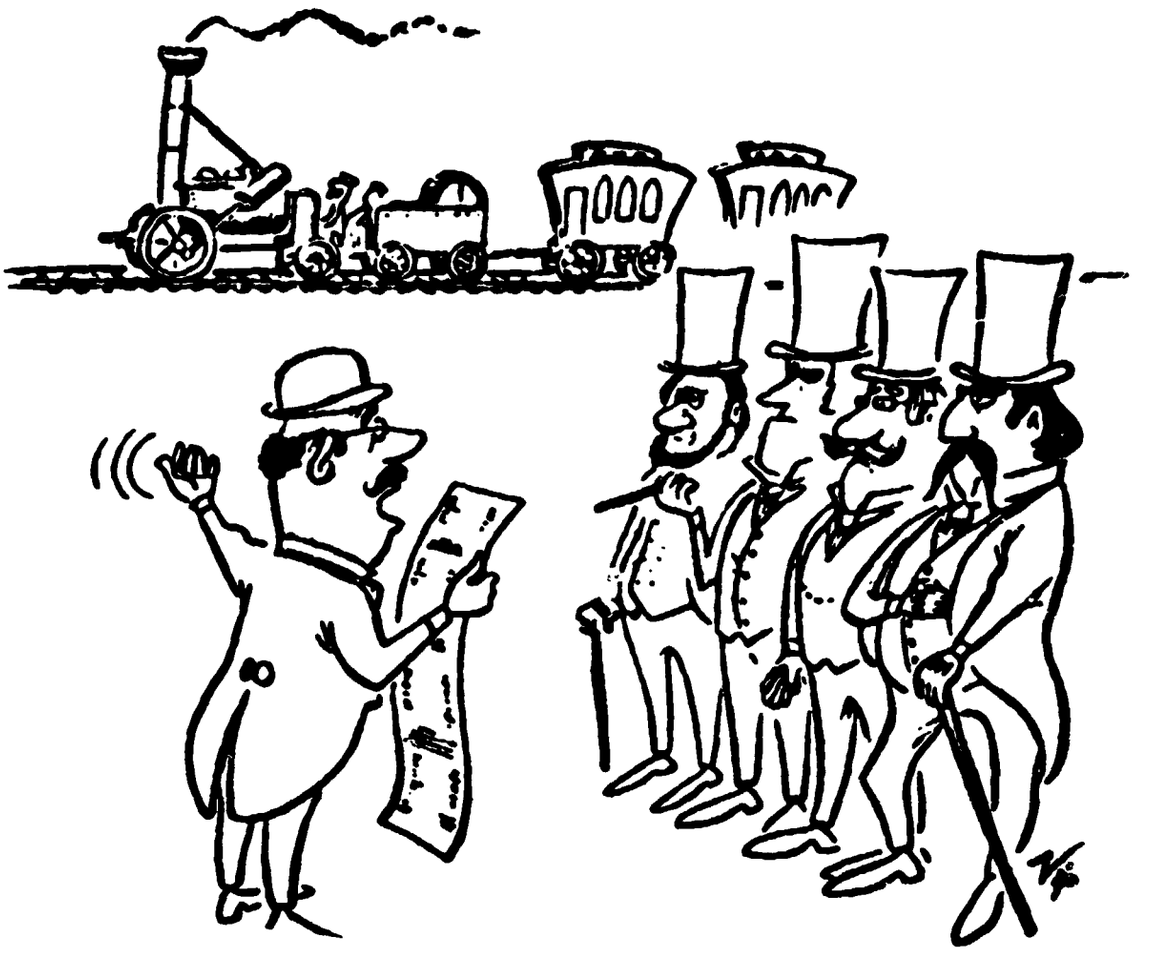
Conventional Trains. Improvements have been made in track maintenance (to give greater rider comfort), in management and in the aesthetic design of new systems. The BART (Bay Area Rapid Transit) system is an example. This is an attractive system with computer control, providing connections with bus systems and providing parking lots and dropping-off areas for "park-and-ride" and "kiss-and-ride" customers.

Monorail

The monorail refers to a type of guideway using one rail instead of two, rather than a particular class of vehicle; however, the term "monorail" usually connotes a type of public transportation and will be treated here as such. There are many kinds of monorail systems, but attention will be devoted to the Alweg version, since it appears to be the most popular type for existing installations as well as future proposals. A summary of other types of monorail systems can be found in Berry, Blomme, and Shuldiner, (2). In the Alweg monorail, the vehicle is suspended on the rail in saddlebag fashion, as illustrated in Figure 2-10. Other possibilities include suspending the vehicle under the rail. As with other modes of transpor-

tation, monorail systems have certain advantages and disadvantages.

Because the main advantage of a monorail system is the small amount of land required for the "footprint" of the elevated support systems, it lends itself well for use in congested urban areas where surface land is not available in large amounts, but where tunneling or trenching costs would be prohibitive. A second advantage of monorail systems is that they appear "modern" and innovative to the public, although this image is largely fostered by more recent designs. The monorail system in one form or another, has existed for well over 100 years since it was first introduced in the



"The whole business is economically unsound, gentlemen. With a train of this length and forty miles of track, we find that only .0568 percent of the track will be in use at any given time, representing a constant idle investment of 99.9432 percent."

Tabor R. Stone. BEYOND THE AUTOMOBILE: Reshaping the Transportation Environment (1971). By permission of Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

Listowel and Ballybunion Railroad in Ireland in 1888. Public acceptance of monorail systems would probably be high, assuming it compared favorably with mass transit systems in other respects.

There are a few disadvantages to the monorail concept which are probably responsible for its limited application to date. One of these is the inflexibility of the route design, and the technical difficulty involved in switching the vehicles from one track to another. Most monorail systems operate on a loop where no switching is required except for bringing the vehicle onto a spur for maintenance work from time to time. As a result, many monorail installations, especially in the United States, have been confined to highly specialized applications such as fairs and trade shows. Recently, however, monorail systems have been contemplated for use in specialized applications in Lowell, Massachusetts (28) and Hampton, Virginia.

A second, although minor limitation, is that monorail cars tend to have a certain amount of side-sway for many of the installations. This problem can be minimized with some additional technological applications.

The application of the monorail appears to be somewhat limited because of its "loop" characteristics. Further Research and Development should be devoted primarily to the monorail switching problem. If success is achieved in this area, additional work might then be applied to standardizing track design to permit wider application of this concept.

Tracked Levitated Vehicles

Mechanical support systems such as conventional suspensions and wheels become dynamically unstable at speeds above 130 or 150 mph, thus making the use of wheeled trains impratical above those speeds. Following a report by MIT in 1965 which concluded that the Tracked Air Cushion Vehicle (TACV) offered a great potential for achieving both high-speed intercity or intracity transportation in the 1980's, the Federal Railroad Administration (FRA), then the Office of High Speed Ground Transportation (OHSGT) of the U.S. Department of Commerce, began some analytical and experimental studies relating to the TACV. After a cost-benefit evaluation, the FRA decided to concentrate its high speed ground advance system Research and Development on a system class known as the Tracked Levitated Vehicle (TLV). The FRA is carrying out this work under the High Speed Ground Transportation Act of 1965 (as amended). This system is still in the developmental stage and has as its predecessors the Hovertrain of Britain and the Aerotrain of France. Vehicles are being developed to meet two different sets of specifications:

(1) The original program known as the TACV Project—300 mph with 100 passengers.

(2) The Program transferred from the Urban Mass Transportation Administration (UMTA) as of FY 1974—150 mph with 60 passengers.

The 300 mph vehicle should be well suited for intercity trips in cities with large land areas.

Tracked levitated vehicles will operate over a guideway but with no physical contact to the guideway. The TLV system will require power for two different purposes, one for levitation (or suspension) and the other for propulsion.

Tracked Levitated Vehicles have been classified into two different types according to the suspension systems, Tracked Air Cushion Vehicles (TACV) and Tracked Magnetically Levitated Vehicles (TMLV). There are two methods of obtaining air levitation and two methods of obtaining by using severo-controlled electromagnetics attached to the vehicle and attracted upward to a steel-rail guideway (known as the "attraction" system), or magnetic levitation can be obtained by using cryogenically cooled, superconducting magnets attached to the vehicle and floated over an aluminum guideway (known as the "repulsion" system).

Likewise, there are two methods of propulsion now under test and development. The method which is well developed and being used on present research vehicles employ three turbofan engines. The second method uses two linear induction motors (LIM) each rated for 4,000-hp (2984 Kw) which will operate from a 3-phase, 60 Hz., 8.25 kilovolt wayside electrical power system developing a total of 10,000 lbs. of thrust. All components of the first of the two LIM and power conditioning units were complete as of February 1973 and the unit has been installed in the research vehicle.

For a TACV utilizing ram air for levitation, a propulsion system consisting of a ducted fan powered by a low-pollution turbine has been concluded to be technically more attractive than the LIM propulsion because it combines the propulsion and suspension systems into a single energized fluid system. On the other

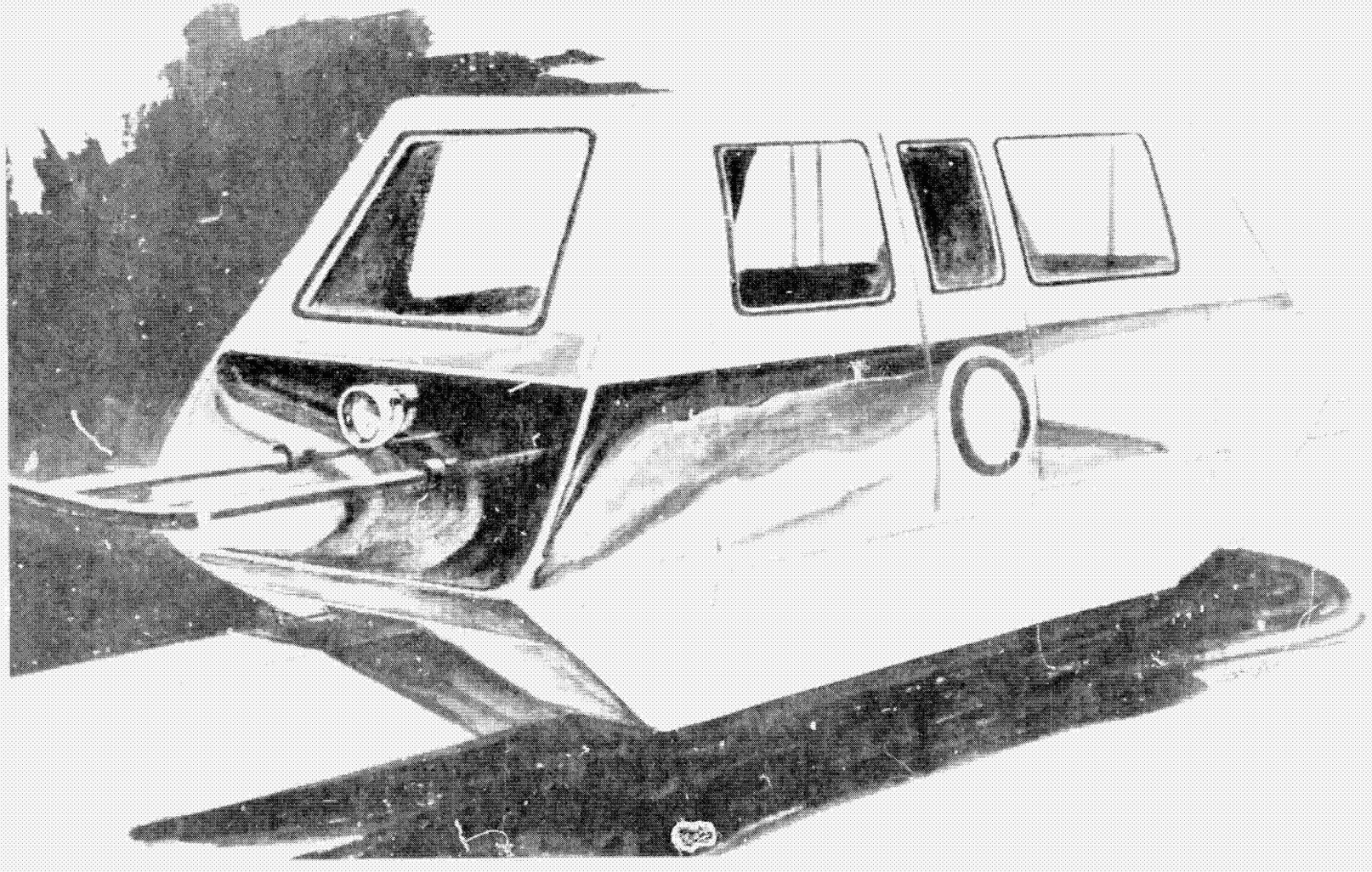


FIGURE 2-10

hand, the linear induction motor offers the advantage of no moving parts, low noise, and no air pollutants. Similarly, the air levitation method and the magnetic levitation method have their advantages and disadvantages. Sufficient information is not available, however, to make a complete comparison. At present, the Federal Railroad Administration is conducting research for the purpose of obtaining information to evaluate the repulsion type magnetic levitation system against the attractive magnetic levitation system. A prototype configuration of the Tracked Levitated Vehicle is expected in about 1977 or 1978. The Northeast Corridor is considered a prime area for the operation of this vehicle

Personal/Group Rapid Transit and Dual-Mode Systems

The brand new San Francisco Bay Area Rapid Transit (BART) system differs primarily from the New York subway system only in its use of more attractive and comfortable vehicles and the highly automated control system it employs. Otherwise the systems are conceptually the same; i.e., mass rapid transit conducted on a fixed route scheduled basis with large passenger capacity vehicles running on tracks with relatively large headways and stopping on the main line of the track to pick up and discharge passengers.

Some new and completely different kinds of urban transportation systems will be discussed in this section of the report—systems which can provide features such as non-scheduled "on-demand" service, small passenger capacity vehicles as well as large ones, nonstop origin-to-destination travel, and off line stopping at stations. An additional desirable feature would be the possible manual operation of the vehicles on conventional highways when so desired.

One of the new concepts having some of these attributes has become known as Personal Rapid Transit (PRT). Briefly, this particular concept, **at its highest level of service,** would consist of a grid of slim automated guideways (below, on, and/or above grade, as needed) with off-line stations spaced close enough in high population density areas to permit reasonable walking access thereto. Small (4-6 passenger) vehicles would provide on-demand nonstop origin-to-destination service. A system offering these features should offer a very attractive alternative to the automobile for many trip purposes. PRT vehicles might be rubber tired, air cushioned, or magnetically levitated and travel on the guideways at 30 to 40 miles per hour.

If required during periods of peak traffic, service could be provided on a scheduled basis, and at other times when traffic is not heavy, nonstop "on-demand" service would be possible. Passengers would probably purchase magnetically encoded tickets which would be inserted in a fare collection gate. To gain access to station boarding platforms after entering the gate, the passenger would press a button to indicate his destination and then board a vehicle which would be dispatched automatically for him. Upon arrival at his destination, the ticket would again be inserted in a device which would subtract from the ticket's value the cost of the ride.

A very complete description of PRT system characteristics, capabilities, costs, availability and suggested means for determining applicability may be found in Casey (11); a document prepared and designed for use by state and metropolitan planning bodies as part of a technical assistance package to be included with the 1974 National Transportation Study. Two other valuable sources of information regarding the system are Anderson (6) and Anderson, Dais, and York (7).

That there is a real and growing interest in the PRT concept is attested to by the following events reported in *New Concepts in Urban Transportation* (41). The Denver Rapid Transit District selected a systems engineering team in March 1974 to develop a 98-mile PRT system to serve as a major component in its planned integrated public transit system. Proposals to design and contract for an 8,000 feet double guideway with seven stations and a 12,000-passenger-trip-per-hour capacity have been requested by the Inter-American Center Authority of Miami, Florida. Actual construction of a PRT demonstration line at the Canadian Exhibition grounds at Toronto is well underway and the system should be operational in 1975. This particular system will employ magnetic levitation for support rather than the wheel and should provide valuable experience as to the feasibility of this novel method. Support, guidance, and propulsion of vehicles on guideways by electromagnetic forces appears to be one of the more promising technologies of the future, for both the PRT systems and also for other means of ground transportation (38, pp. 17-25).

Since the research, development and testing of PRT type system prototypes is in an embryonic stage, some rather severe "growing pains" should naturally occur. One of the more

celebrated cases has been the ill-fated Morgantown, West Virginia, project. Even though extremely costly and not very successful, much valuable experience was obtained. Subsequently designed and constructed systems at the Seattle-Tacoma International and the Dallas-Fort Worth Airports (35) are becoming fully operational in a much more successful manner and perform the additional function of moving freight.

Another concept which can be potentially combined with PRT is the configuring of the vehicles for maunal operation on ordinary streets when not automatically travelling on the guideways. The Japanese intend to demonstrate such a dual-mode PRT system at their Marine Exposition on Okinawa during the summer of 1975.

The dual-mode concept is not, of course, restricted to small PRT-size vehicles and has been applied to much larger passenger capacity vehicles. One such application is the "Bimodal Transit Vehicle" discussed later in this chapter. Possibly the first large metropolitan area transit system to incorporate the dual-mode scheme with that of automated guideway travel will be of this kind which, incidentally, is quite similar to a system studied by the General Motors Transportation Systems Division (30).

When a system provides a boldly different kind of transportation, i.e., personalized, on-demand, automated travel along with the potential for mass transit, freight movement and dual-mode operation, one can expect that a number of extremely costly prototype systems will be required before acceptable levels of operational and cost effectiveness are attained. Accordingly, there is no anticipation that the new concepts discussed here actually will be incorporated in urban transit systems to any great extent during this century unless a national commitment comparable to that of the space effort is made.

VTOL Aircraft

There are many forms of VTOL aircraft that could be considered in an analysis of transportation modes and which could be made available for urban use within a reasonable time span. Among these are the pure helicopter, compound helicopter, tilt roter, tilt wing, lift fan, and lift jet. However, only the helicopters will be discussed here, as other forms of VTOL aircraft still need considerable development before they would be available for public use. Figure 2-11 shows an example of a type of helicopter being considered.

The major advantage of any aircraft system, compared to a ground operating system, is that no roadway or guideway is needed. This provides for much greater flexibility in route selection or variation in response to changes in demands. For the same reason, there are no roadway or guideway construction costs, thereby confining capital costs to the terminal building and landing sites, and to the cost of the aircraft. Since the helicopter requires no runway, "heliports" can be built for a fraction of conventional airport costs, and can be located reasonably close to city centers, often on top of buildings or in parking areas within the central business district.

The main source of irritation to the host community is most likely to be the noise generated by the aircraft during landing and takeoff operations; however, considerable work is being done currently in the area of noise reduction. Within a few years, the noise level should be well within tolerable limits.

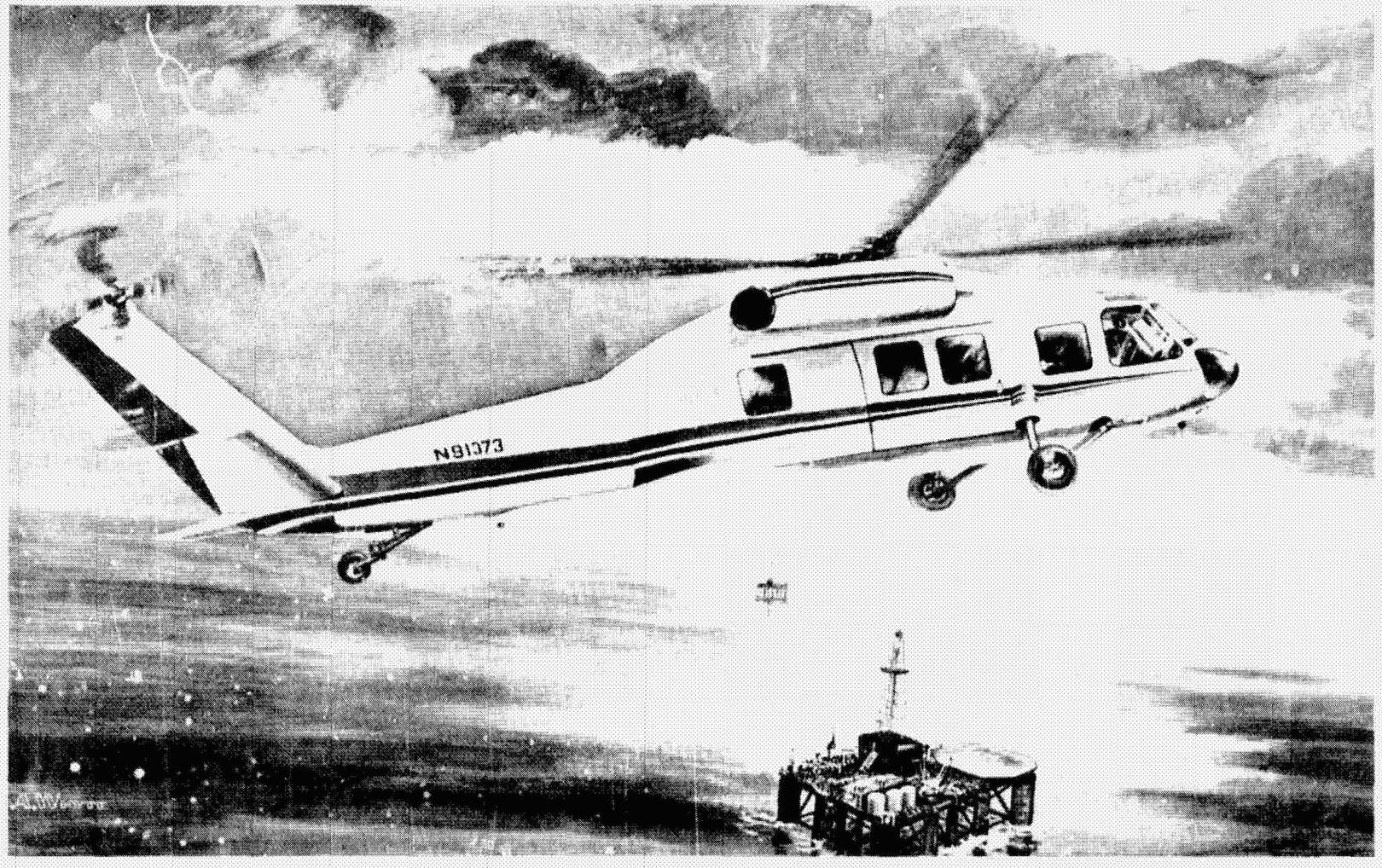
Some air pollution problems may be locally increased due to helicopter operation in confined areas, but this also appears to be well on its way toward solution. While flying enroute, the pollutant emissions of a helicopter in terms of grams/passenger-mile are considerably less than those generated by the automobile.

Another problem area is related to the use of the helicopter in weather of limited ceiling and visibility. Helicopters can be operated under some weather conditions that would ground other conventional aircraft. But such weather could deteriorate to the point where even the helicopter would be grounded. An area of research at this time is the development of ground-air instrument systems to allow the use of helicopters during periods of very bad visibility.

Probably the single biggest problem in helicopter operations is the high direct operating costs of the helicopter, currently running around 15¢ per seat mile; however these could be lowered to more reasonable values by proper route selection and reasonable passenger loading.

Stout summarized a study of the use of aircraft, especially helicopter-type aircraft, in intraurban transportation. His summary addresses the problem areas discussed above (26).

A detailed study of the use of helicopters in air transit was conducted by the NASA-ASEE Engineering Systems Design group at NASA-Ames in 1969 (12). This study considered



S-70C-20 ADVANCED PASSENGER/UTILITY HELICOPTER SIKORSKY AIRCRAFT

FIGURE 2-11

several candidate VTOL and STOL configurations for use in a Southern California scenario. The configuration selected as being best suited for intraurban trips of mean stage length equal to 40 miles was a compound helicopter similar to the proposed Sikorsky S-65-20C model. The advantage of the compound helicopter is that it can take off vertically and yet cruise at speeds of 250 mph by transferring some of the lift from the rotor to a short wing.

The detailed study at Ames considered the following items: avionics, terminals, noise, market and operations analysis, and systems evaluation. General conclusions of the study were that the high operating costs of the helicopters would probably restrict the number of commuter customers that the Metropolitan Air Transit system could attract. A helicopter airline system was felt to be useful, however, for attracting a large number of airline passengers by transporting them from special outlying terminals to the conventional airline terminals.

Comparing the Southern California area with Tidewater, Virginia would seem to indicate that a helicopter airline system could perform the same function in Tidewater; however, it would probably be even less efficient in Tidewater because of the lower density of population and industry. The NASA-Ames study (12) presented a design methodology that could be applied to various areas of the country to examine the current suitability of commuter helicopter operations.

Future developments will undoubtedly lower the direct operating cost of the helicopter and make it more competitive for passenger service, but this is likely to be a slow process unless major breakthroughs occur in the design and maintenance of helicopters. Until that time, helicopter airline service probably will be limited to highly congested areas such as New York City (i.e., New York Airways, a helicopter airline). In such locations, a large enough supply of customers willing to pay the high fares currently exists.

Transportation System Costs

Having considered the technology, characteristics, and advantages and disadvantages of different types of transportation systems, one naturally feels a need for a summary comparison of features. One of the most desirable types of information for decisionmakers is a presentation of the relative costs of various options. Transportation experts realize that comparative cost data must be interpreted very cautiously. The calculation of comparable figures is a monumental task which requires a number of highly restrictive assumptions. The relationships could shift dramatically depending upon the specific characteristics of the area considering transportation system investment.

In spite of all the dangers of generalizing, rules-of-thumb and rough estimates are adopted, and they can affect the decisions made by communities. Therefore, this report can help to provide perspective by considering some available cost information.

Richard Rice has compiled an extensive list of cost data related to transportation systems (20, pp. 94-95). This includes the roadway or guideway as well as vehicle acquisition costs. Realistic project evaluation would require consideration of length of life, operating expenses, necessary support services, etc. Nevertheless, they do provide some indication of what a metropolitan area might have to pay to get a subway, rather than more highways. Tables II-VI and II-VII are adapted from Rice and presented on the assumption that the reader will keep in mind their tentative nature.

Further data on public transportation system costs are presented by Dietrich R. Bergman in a report for the Michigan Bureau of Transportation (10, pp. 48-49). Table II-VIII presents figures on line-haul buses, commuter rail transit, streetcars, small rail vehicles, and other systems. While Rice used typical figures, Dietrich presents rather wide ranges.

Tables of data such as these can be supplemented with reports from specific systems such as BART or Metro. They can also provide some perspective for judging the accuracy of projected costs for new innovations or specific installations. However, each urban area would need far more specific information on which to base any actual decisions with respect to its transportation system.

Comparisons of Energy Consumption

In comparing modes of transportation for making any kind of recommendations, the "energy effectiveness" of the mode must be considered. One useful method is in terms of passenger-miles/gallon, sometimes called "transportation energy efficiency," or "net-propulsion efficiency."

One good way to visualize the comparison of energy effectiveness of various transportation modes, both existing and proposed, is to list them in a table. This provides a basis for rapid comparisons of speed, passenger load-

TABLE II-VI

Right-of-Way and Facility Costs for Surface Transportation Systems (1968 Levels)

Surface Transportation System	Typical Cost/Mile
4 Lane Divided Highway	$ 1,200,000
4 Lane Divided Urban Highway	6,000,000
6-8 Lane Metropolitan Divided Highway	10,000,000
2 Lane Dry Rock Tunnel (30 ft. diameter)	10,000,000
4 Lane Concrete Viaduct	4,000,000
Typical Highway Cloverleaf	300,000
Typical Urban Cloverleaf	1,000,000
2 Track Railway (Track only)	300,000
2 Track High Speed Electric Railroad	500,000
2 Track Rapid Transit, elevated surface, including stations, buildings, etc.	9,000,000
1 Small subway station	4,000,000
LAND COST PER ACRE:	
Rural	$ 1 - 3,000
Urban	3 - 15,000
Metropolitan	20 - 100,000

Source: R. Rice, "Historical perspective in transport system development." *Advanced Urban Transportation Systems.* Pittsburgh: Carnegie-Mellon University, p. 94.

TABLE II-VII

Acquisition Prices for Transport Vehicles (1968 Levels)

Transport Vehicle	Acquisition Price
Buses	
Stretched Cab Limousine	$ 8,000
School Bus	15,000
Small Transit Bus	25,000
Regular Transit Bus	30,000
Deluxe Air-Cooled Transit Bus	35,000
Rail Transit Equipment	
Electric Streetcar (40 Seats)	70,000
Light Rapid Transit Car (40 Seats)	125,000
Standard Rapid Transit Car (50 Seats)	150,000
Deluxe Rapid Transit Car (80 Seats)	200,000
Other Vehicles	
24 Seat Helicopter S-65	1,700,000

Source; Rice, R., p. 95.

ing, and passenger-miles per gallon. In making such a comparison, the purpose for which the vehicle will be used must be considered.

For example, the efficiency of an automobile is quite different in intraurban, stop-start type of driving than it is when cruising along the highway. In addition, certain modes lend themselves well to intraurban operation, but are not nearly as suitable for intercity operation. A good example of this is the electric auto which is clean in its operation, but requires frequent battery charging. Thus, in its current state of development, it is not suitable for driving very long distances. On the other hand, aircraft lend themselves well to intercity operation, but except for the helicopters, are not currently a viable means of intraurban transportation. A similar statement might be made for conventional rail service in many cases.

To aid in comparing some of these transportation modes, Tables II-IX through II-XI are presented. These tables include most of the commonly available and proposed modes of transportation, with the exception of water craft.

Table II-IX summarizes those modes of transportation suitable for intraurban use. A comparison of the values in the right hand column for passenger-miles per gallon shows that the bus is a very efficient mode in this respect. (A detailed description of the bus as a mode of transportation was given earlier in this chapter.) Note also, however, that a subcompact car carrying four passengers is as energy efficient as a full size diesel bus only half full. This suggests that car pooling with four or more passengers can be relatively energy efficient.

Table II-X summarized the energy efficiencies of various modes operating in an urban/suburban environment. Buses still appear to be very energy efficient in this mode of operation. Note that pneumatic tubular vehicle systems come out high in this comparison, but much work yet remains to be done to develop the technology and reduce the costs of pneumatic tubular vehicle systems.

Table II-XI compares various modes operating on an intercity basis, and aircraft enter the comparison at this point. Buses still rate high, with gas turbine buses and Stirling engine buses comparing favorably.

Another useful way of comparing these values of transportation energy efficiency is to display them graphically, with speed entering as one of the factors in the comparison. Figure 2-12 compares the efficiency for many different modes of transportation, both ground and air. Figure 2-12 is from a different source, and the values plotted on this figure may differ in some respects from those values presented in Tables II-IX through II-XI. In addition, several modes of transportation are presented in this figure which were outside the scope of the present study. Nevertheless, the type of comparison shown in Figure 2-12 serves to provide a meaningful comparison of the modes.

In this figure, the net propulsion efficiency is plotted as a function of speed. Points to the upper right of the figure represent more "efficient" modes of travel, since they have a high value for passenger-miles/gallon and a high speed, thus minimizing passenger time that might be "wasted" during travel. Points to the lower left are both low in speed and low in energy effectiveness. Based on the figure, buses again are seen to be energy efficient.

Vehicles such as the advanced passenger train and the linear turbines appear to have a high energy effectiveness, but any points presented for proposed vehicles are based on estimated efficiencies, and hard data will only be available when prototypes are put into operation and actual measurements are made. Nevertheless, the points on the figure for proposed vehicles give some indication of those which appear promising from an energy consumption viewpoint.

A Composite System

Different modes of transportation have different characteristics. A mix of different modes to build a composite system would require that they be selected so as to capitalize on their most favorable characteristics. For example, the automobile is private, flexible, dependable, and immediately available. A bus may be cheaper to ride, dependable, reliable, and fairly flexible in routing. Rapid rail transit or modes that have private right-of-way are fast but not always convenient, and are usually operated on a fixed schedule. A good composite system would combine each of these modes and provide either door-to-door or station-to-station transportation. There would be no transfers, or at most one transfer, between vehicles for intracity travel. A patron could walk to a station (or perhaps be picked up at home as with the dial-a-ride concept), board one vehicle and be transported to the door of the destination of choice.

Possibly each urban area would be served best by a unique combination of modes. Any proposed system must be based on a continu-

TABLE II-IX
TRANSPORTATION/ENERGY DATA FOR INTRAURBAN SYSTEMS

MODE	BLOCK SPEED (MPH)	AVERAGE FUEL CONSUMPTION (MPG)	PASSENGER LOADING		$\eta_{T/E}$ (PASSENGER-MILES / GALLON)	
			LOAD RANGE (PASS/VEH)	LOAD FACTOR (%)	RANGE	AVERAGE
A. Automobiles						
1. Luxury	5-20	12.5	1-6	28.3	13-75	21
2. Full Size	5-20	13.2	1-6	28.3	13-80	22
3. Intermediate	5-20	14.1	1-6	28.3	14-85	24
4. Compact	5-20	17.3	1-4	42.5	17-70	30
5. Subcompact	5-20	26.5	1-4	42.5	27-105	45
6. Diesel	5-20	24.0	1-5	34	24-120	40
B. Motorcycles	10-25	30-80	1	110	35-90	60
C. Bus Transit						
1. Full Size Diesel	5-15	4.1	41-53	45	75-100	90
2. Medium Size Diesel	5-15	5.5	25-33	45	60-80	70
3. Medium Size Gasoline	5-15	4.5	25-33	45	50-70	60
4. Full Size Rankine	5-15	0.6-1.1	41-53	45	10-25	18
5. Minibus Gasoline	5-15	7.2	15-25	45	50-80	65
6. Van Gasoline	5-15	9.0	6-10	45	25-40	32
D. Rail Transit						
1. Subway and Elevated	15-30	2.5	50-80	35	45-70	60
2. Surface Rail	15-25	3.0	50-70	35	50-75	65
3. Trolley Coach	10-25	3.2	40-60	35	45-70	55
E. Potential Future Systems						
1. Electric Auto	5-20	20-25	1-4	42.5	20-100	40
2. Sterling Bus	5-15	5-7	31	45	70-100	85
3. Rankine Bus	5-15	2.3-3.3	41-53	45	40-80	60
4. Personal Rapid Transit (PRT)	10-30	25-30	4-6	26-32	35-50	40

Ref: Goss, W.P., and McGowen, J.G., "Energy Requirements for Passenger Ground Transportation Systems," Inter-society Conference on Transportation, American Society of Mechanical Engineers, Denver, Colo., Sept. 1973.

TABLE II-X
TRANSPORTATION/ENERGY DATA FOR SUBURBAN/URBAN SYSTEMS

MODE	BLOCK SPEED (MPH)	AVERAGE FUEL CONSUMPTION PER VEHICLE (MPG)	PASSENGER LOADING		$\eta_{T/E}$ (PASSENGER-MILES / GALLON)	
			LOAD RANGE (PASS/VEH)	LOAD FACTOR (%)	RANGE	AVERAGE
A. Automobiles						
1. Luxury	15-35	12.5	1-6	23	13-75	18
2. Full Size	15-35	13.2	1-6	23	13-79	19
3. Intermediate	15-35	14.1	1-6	23	14-85	20
4. Compact	15-35	17.3	1-4	35	17-69	24
5. Subcompact	15-35	26.5	1-4	35	27-106	37
6. Diesel	15-35	24	1-5	28	24-120	35
B. Motorcycles	15-40	30-80	1	130	40-105	70
C. Bus						
1. Full Size Diesel	10-35	6.5	41-53	45	120-155	140
2. Medium Size Diesel	10-35	8.0	25-33	45	90-120	105
3. Medium Size Gasoline	10-35	5.5	25-33	45	70-80	75
4. Full Size Rankine	10-35	2.0	41-53	45	40-50	45
D. Commuter Rail						
1. Electric	25-45	1.9	70-125	35	50-85	65
2. Diesel	25-45	1.6	50-90	35	30-50	40
3. Gas Turbine	25-45	1.0	60-80	35	20-30	25
E. Potential Future Systems						
1. Hybrid Electric Auto	10-30	15-24	1-4	35	15-100	30
2. Gas Turbine Auto	15-35	12-14	1-5	30	18-21	20
3. Stirling Bus	10-35	5-7	41-53	45	90-170	130
4. Rankine Bus	10-35	2.3-3.3	41-53	45	40-80	60
5. TACV	40-60	.3-.4	60-120	62.5	10-30	25
6. TVS Pneumatic	40-60	1.7-2.5	60-120	50	50-150	100
Non-Pneumatic	40-60	1.3-1.7	60-120	50	40-100	60

Ref: Goss, W. P., and McGowan, J. G., "Energy Requirements for Passenger Ground Transportation Systems," Inter-society Conference on Transportation, American Society of Mechanical Engineers, Denver, Colo., Sept. 1973.

TABLE II-XI
TRANSPORTATION/ENERGY DATA FOR INTERCITY SYSTEMS

MODE	BLOCK SPEED (MPH)	AVERAGE FUEL CONSUMPTION PER VEHICLE (MPG)	PASSENGER LOADING		η_{TIE} (PASSENGER-MILES / GALLON)	
			LOAD RANGE (PASS/VEH)	LOAD FACTOR (%)	RANGE	AVERAGE
A. Automobiles						
1. Luxury	40-60	12.5	1-6	35	13-75	26
2. Full Size	40-60	13.2	1-6	35	13-79	28
3 Intermediate	40-60	14.1	1-6	35	14-85	30
4. Compact	40-60	17.3	1-4	53	17-69	36
5. Subcompact	40-60	26.5	1-4	53	27-106	56
6. Diesel	40-60	24.0	1-5	42	24-120	50
B. Buses						
1. Highway Coach Diesel	40-60	7.0	41-53	46	130-170	150
2. Highway Coach Gas Turbine	40-60	2.5	41-53	46	50-60	55
C. Rail						
1. Electric	50-70	2.5	70-125	37	65-115	90
2. Diesel	50-70	2.1	50-90	37	39-70	55
3. Gas Turbine	50-70	.5-.7	140-240	37	28-61	50
D. Air						
1. Short Range	200-300	.2-.4	75-150	50	10-30	15
2. Long Range	400-500	.2-.4	150-350	50	10-40	20
E. Potential Future Systems						
1. Gas Turbine Bus	50-70	4-5	41-53	50	80-130	105
2. Stirling Bus	50-70	5-7	41-53	50	100-190	140
3. TACV	100-250	.4-.5	60-120	63	15-40	30
4. TVS						
Pneumatic	100-300	1.1-1.9	60-120	55	35-125	80
Non-Pneumatic	100-300	.8-1.1	60-120	55	25-75	50
5. VTOL	125-200	.24-.37	50-100	55	7-20	15
6. STOL	125-200	.33	100	55	10-20	18

Ref: Goss, W. P., and McGowen, "Energy Requirements for Passenger Ground Transportation Systems," Intersociety Conference on Transportation, American Society of Mechanical Engineers, Denver, Colo., Sept. 1973.

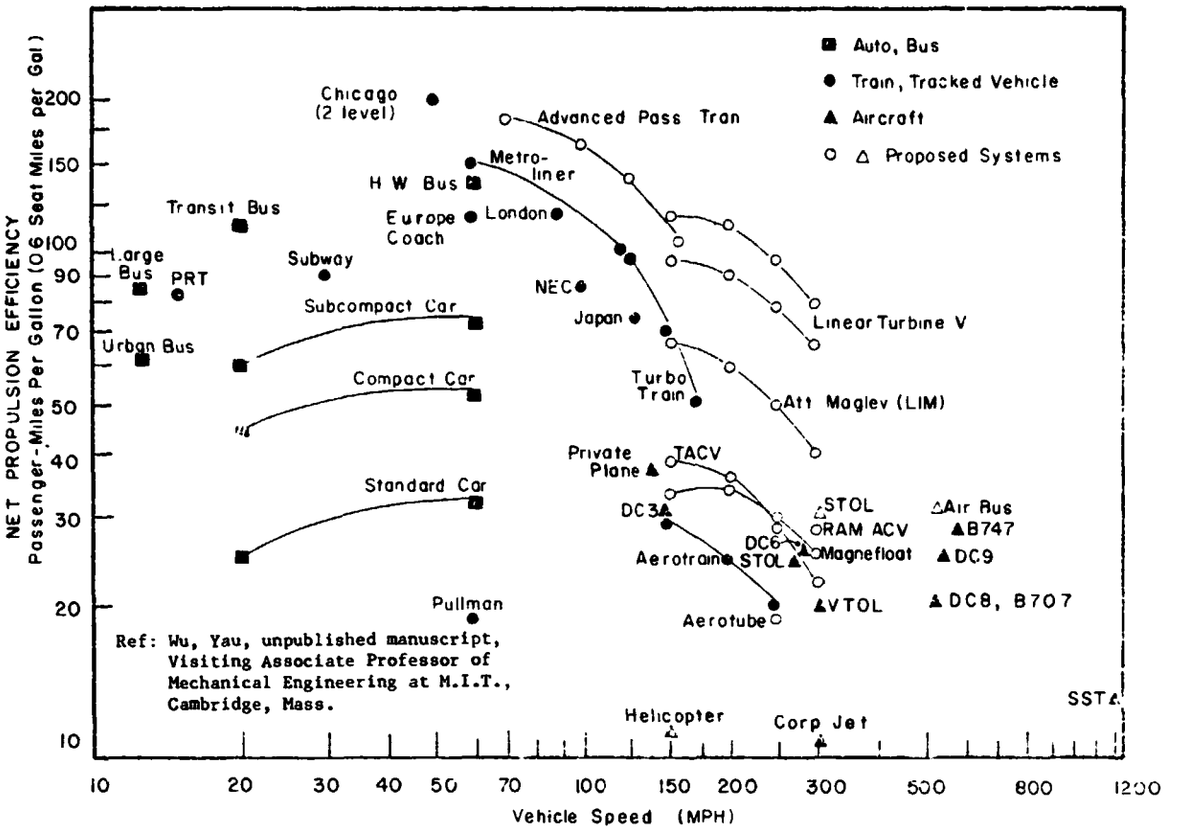


FIGURE 2-12
NET PROPULSION EFFICIENCY OF GROUND AND AIR TRANSPORTATION

"Yes, a little—but not on land—and not with needles—" Alice was beginning to say, when suddenly the needles turned into oars in her hands, and she found they were in a little boat, gliding along between banks: so there was nothing for it but to do her best.

—Lewis Carroll

ing widespread use of the automobile. This could be supplemented by the use of public transit vehicles which are capable of running on both the highway network and on automated guideways. In this system, small and medium sized buses would pick up passengers at either their homes (dial-a-ride or subscription service) or at stations (fixed route service). They would travel to a guideway where there is access and egress and form "trains" of buses on the guideway that would be under the control of a central computer. These trains of buses would then move on the guideways at high speeds. Stations would be off-line, allowing shorter headways and higher speeds on-line. Such a system can, of course, be combined with other types of high-speed or air transport along high density regional transportation corridors.

A system which combines the most desirable features of dial-a-ride, fixed-route transit, PRT, and dual mode has been suggested recently by the Toledo Area Regional Transit Authority (TARTA). The TARTA system will use 33-passenger buses that will travel a fixed schedule on the city streets (see Figure 2-13) and also have a separate guideway system (see Figure 2-14) to allow for high speed transportation between different city areas. The buses can go up (or down) ramps, form into trains, and be

FIGURE 2-13

FIGURE 2-14

under the control of a computer while on the guideway. The guideways have off-line station stops that allow trains to pass the station if no passenger wishes to depart at that station. The system will allow a passenger to move faster and will reduce the number of transfers needed to go from origin to destination. The TARTA proposal is th have 14 miles of guideway and 16 stations constructed by 1985, with future expansion of the system occuring as the need arises. Projected costs for installing the dual-mode system is in line with costs for other systems. (Figure 2-14). Grade, elevated, and open cut construction costs are estimated to be $550,000; $4,700,000; and $1,400,000 per mile of two lane guideway. With station costs of $500,000 each and vehicle costs estimated at $75,000 for a 33-passenger bus, the system is much less expensive than conventional electrical rail transit systems. Although TARTA refers to the system as a Bimodal Transit Vehicle (BTV), it is a composite bus-based system that shows great promise for the future in areas where rapid transit is feasible because of high density.

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TRANSPORTATION AND MODAL CHOICE

3

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Chapter III

TRANSPORTATION AND MODAL CHOICE

I. Introduction

The transportation problem is a part of an increasingly complex world in which each technological success we enjoy often creates a new set of problems more complex and more difficult than the original ones. Put another way, demands for transportation systems—for vehicles, roads, tunnels, tracks—are met by technological change which itself creates further difficulties (such as pollution, resource depletion, and so on), which in turn have traditionally been met by still more technology.

In Chapter II, some of the latest and most promising transportation hardware innovations were discussed. However, there may be other ways to look at problems in transportation by going straight to the source of the demand: people. This section will discuss a frequently overlooked approach to the transportation problem: an examination of "people" problems rather than "technological" problems. Can the demand for transportation be modified? If it can, there appear to be three possible avenues of approach: (1) effecting the process of modal choice; (2) changing the need and desire for transportation, and, (3) developing new substitutes for transportation, such as electronic communications.

History has shown us that people's attitudes are crucial determinants of the transportation problems of urban areas. In Great Britain, during the Middle Ages, the fear of possible robbery and murder kept a vast majority from traveling outside the relative security of their walled urban village. People today stay in their walled urban apartments out of the same fears (6, p. 1054). Thus, concern for personal safety inadvertently acted as a demand modifier reducing the potential need for transportation between population centers. Conversely, people now have positive attitudes towards transportation. They want to be on the go. The jet setter who whisks from New York to London as a matter of routine sets the pace for industrial society.

As movement from place to place has become more attractive, transportation needs have increased exponentially and brought proportionate increases in accompanying problems. Transportation demand must be modified in some way to conform to a responsible pattern congruent with the goals of our society.

Concern for demand modification, as an alternative approach to the transportation problem, has been developed in this chapter in three main areas. First, there is a discussion of demand from a psycho-social viewpoint by defining certain relevant human factors which should be included in transportation planning. Second, transportation alternatives will be considered in terms of their potential for reducing the need to travel. Third, institutional changes,

While magic carpets would solve our transportation problems, a more practical solution is needed.

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especially with respect to pricing, are suggested as ways to modify the amount of travel and the choice of mode.

II. Human Factors

A. Transportation as an Expression of Conscious Awareness

An individual begins life with only a remote awareness of the almost limitless possibilities which the environment holds. The neonate becomes vaguely familiar with the spatial parameters of his own body environment as his mother caresses him. Each new day bringing the world into sharper focus for the infant as his eyes begin to fixate on more distant objects, thus expanding the visual circumference of his experiential world and deepening his conscious realization of the universe around him.

As information about the world-at-large increases, the child begins to establish a perception of "I-It" relationships in which the world becomes differentiated into myriad objects, and at times it becomes necessary for the child to bring the object of perception closer to his sensory organs. The development of locomotion satisfies this need as an auxiliary "perceptual" system which, in effect, telescopes the child into a new world of possible sensory experiences. The baby can crawl to the end of his crib to see the ball in a better perspective, while the toddler can walk over to the stove to sense if it really is hot. With the advent of locomotion, the individual's potential universe has expanded. The child now moves to regions previously unknown within his potential experiential field with transportation needs expanding as an expression of growing individual consciousness.

The relationship between the child's perceptions and his locomotive needs can also be applied to the Community of Man. Transportation networks are built as man becomes aware of potential resources toward which he would like to travel. Thus, in the United States, railroads to the West were inauguarated as men began to perceive the existence of resources previously untapped. On a more limited scale one finds that highways are designed to transport people and freight to areas where they perceive a need to go.

Transportation systems can also be seen as catalysts in the social dynamics of a community. With the inclusion of a transportation system into the community, individuals begin to engage collectively in trans-spatial activities, no longer limited by their geographic boundaries.

Each transportation system can be defined in terms of certain inherent characteristics. Likewise, these same system characteristics contribute in a unique way to the individual movement pattern of a given urban environment. The subway system in Manhattan has encouraged an entirely different form of social movement than has the widespread use of freeways and cars in Los Angeles. Both New York and Los Angeles are urban centers, but each has its own characteristic transportation system and individual social movement styles.

These social movement styles, which are the result of particular forms of transportation systems, can be classified into two general movement patterns—sociopetal[1] and sociofugal[2] (See Figure 3-1). Sociopetal social movement is best associated with the use of the automobile as a primary transportation mode and results in dispersion of population into expansive living spaces. Los Angeles provides an excellent example of sociopetal social movement.

The second form of social movement can be called sociofugal, which acts as a catalyst for social concentration where business, entertainment, and residence are in close geographic proximity. This form of social movement is related to effective mass transit. Some of the newer European cities are excellent examples of sociopetal development.

B. Transportation as a Function of Attitude

The private automobile is synonymous with the American style of life. In spite of ever-increasing congestion, pollution, and dwindling fuel supplies, the commuter continues to choose the car as a most favored mode of transportation. Little thought, if any, is given to using alternative means of locomotion. The "civilized" American commuter has been brought up with the car as a constant factor in his environment.

From a psycho-social perspective, this reliance on the automobile is more than merely a choice of available technology. The freedom to choose has been narrowly restricted by the use of certain advertising techniques which favor the private car as a desirable mode of

[1] [2] These were originally used by Sommer in conjunction with his research on seating arrangements and its effects on socialization. Application of terms seem to have equal relevance in the present discussions (6, p. 235).

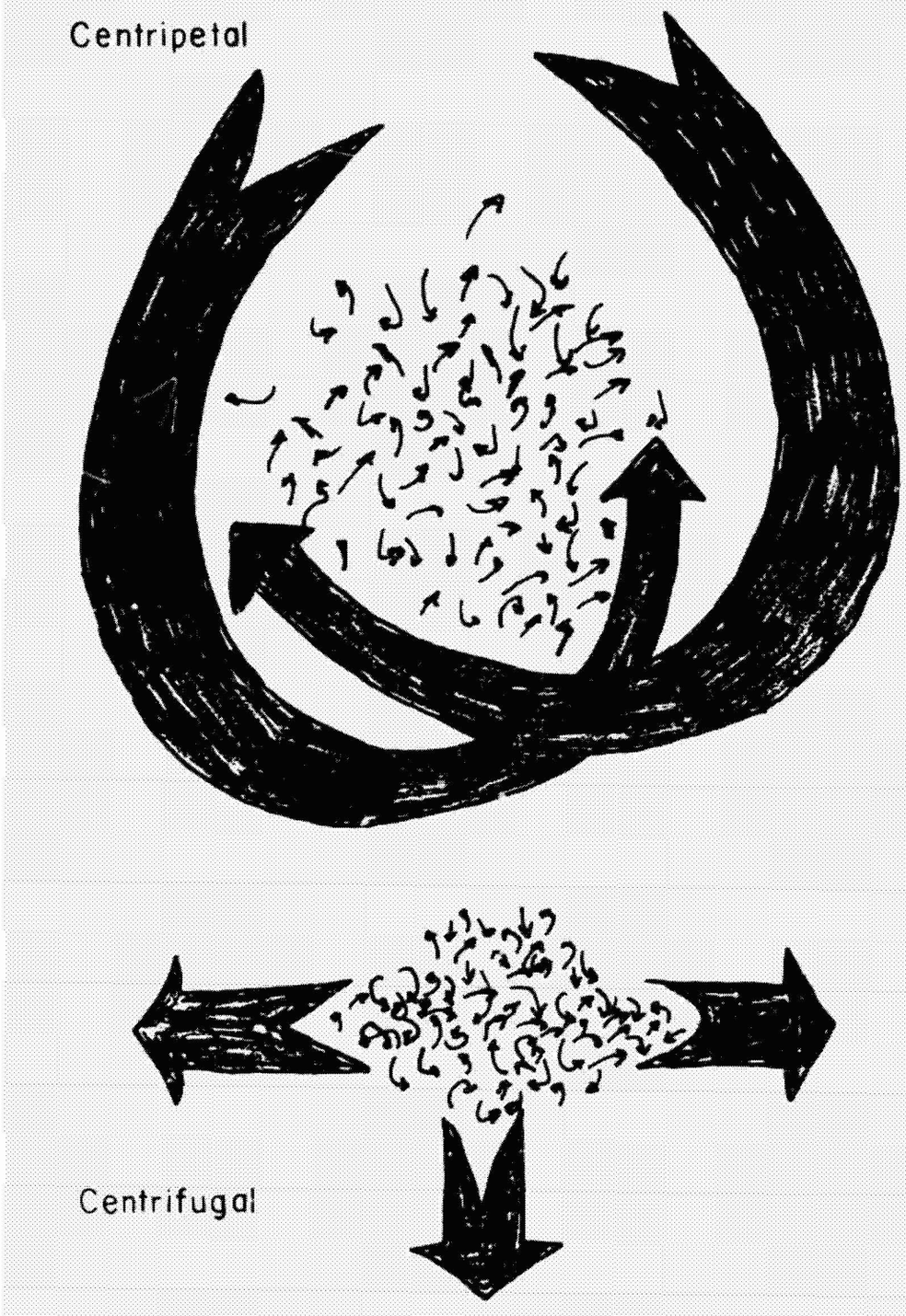
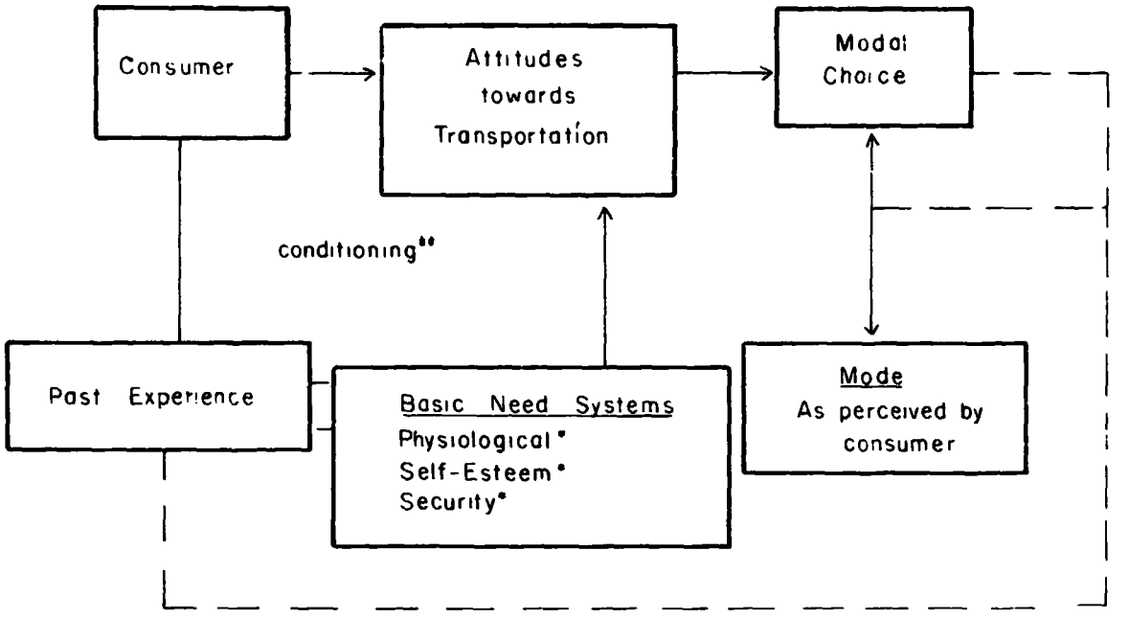


FIGURE 3-1
SOCIAL MOVEMENT STYLES

transportation. The public has been exposed to a most successful program of conditioning which has shaped its attitudes toward transportation. The car as a stimulus has been associated in the past few decades with a number of powerful reinforcers. Women are attracted to men who ride in luxury sports cars and not to a Casper Milquetoast who arrives in a City Transit Authority bus. The affluent (or those striving to appear so) are associated with late model luxury cars, not with broken-down buses. Cars have indeed become a Pavlovian conditioned stimulus for millions of Americans.

Newspapers also indirectly reinforce the car as a desirable choice by appealing to an individual's needs for personal safety. Each day the car owner can read about the latest mugging on city's rapid transit system. In an attitude study done by the Milwaukee and Suburban Transport Corporation, almost 46 percent of the respondents said that personal safety needs were an important consideration in determining when and where they would travel on public transportation (7, VIII - 13-17). Furthermore, out of this group who were motivated by personal safety needs, only a small percentage (7%) ac-



* have been associated in part with transportation
** subject to change

FIGURE 3-2
PSYCHO-SOCIAL DETERMINANTS OF MODAL CHOICE

tually witnessed a crime while almost 60% were influenced by what they had read in the newspaper, heard on radio/TV, or been told by a friend. This seems to indicate that news dissemination is a powerful source of conditioning modal choice attitude.

The middle class suburbanite uses the car instead of the bus because "bus transportation is for domestics." Attitudes of self-enhancement have long been attached to car ownership. For the teenager, car ownership is somewhat akin to rite of passage from the adolescent world (in which one is geographically dependent) to the adult world of relative independence. The car offers its owner increased self-esteem. Such attitudes about the car must be reshaped through a public education process.

These attitudes are the result of conditioning and as such are subject to change. Attitudes which influence modal choice are no less subject to conditioning or change than are other predispositions. Figure 3-2 gives a model for consumer attitude formation and resultant transportation choices. Modal choice can be said to be the function of two independent variables (i.e., attitudes towards mass transportation and individual perceptions of a given mode). It can further be stated that attitudes are shaped in part by an individual's own need system. According to Maslow's hierarchy of needs (39, p. 93), one would expect some need states to exert more primary influence than others. For example, the need for personal safety will be a more influential variable in shaping attitudes initially than would be the need for beauty, an esteem need which would become salient only after basic needs had been at least partially satisfied (33).

It can further be stated that the perception of individual modes (convenient and reliable versus unsafe and unreliable) will determine specific forms of transportation. Thus there is an interaction between the subjective perception of available transportation modes and attitudinal sets. Attitudes toward transportation affects the perception of modes, and the perception of modes affects attitude shaping as part of the individual's past experience (See Figure 3-2). Extrinsic environmental changes will change the individual's perception. This in turn will change attitudes which are influential in shaping modal choice. Logic would suggest

the advantage of changing existing systems to accommodate our basic need system. Systems must be designed which are safer, less crowded (or at least perceived as such), and which protect the "identity" of the rider.

If variables such as personal comfort and safety were considered, mass transportation could be changed into a more accommodating system, meeting more individual needs and thus increasing ridership. As these nonattractants are reduced, ridership can be expected to increase. Figure 3-3 suggests a relationship between mass transportation responsiveness (M.T.R.) and positive consumer attitudes. Mass transportation responsiveness is expressed as the percentage of total trips taken by mass transit.

One can hypothesize certain social/class differences in this presumed curvilinear relationship between ridership attitude and increased ridership. Lower income groups which are more frequently without access to cars are captives of the mass transportation system. Higher socioeconomic groups may not respond to system changes, while the ridership levels of middle socioeconomic classes may conceivably increase as a result of attitude change.

Thus, over the past five decades the car has been associated with the satisfaction of many of man's psycho-physiological needs, while mass transportation, on the other hand, evolved into a system of collective negative reinforcement. It would seem logical to conclude that a modification of both current attitudes towards mass transportation and those conditions which precipitate these dispositions is needed. Consumer utilization of mass transportation is an example of learned behavior.[3]

A public education program is essential if existing attitudes are to be changed. This program should be directed towards two basic objectives. First, rider education should focus on providing accurate information on different available mass transportation modes. Schedules for buses and trains should be accessible to all and capable of easy comprehension by the rider. Newspapers should be used to provide route data and transportation choices. The PATH System in Rochester New York has utilized newspaper ads and direct contact with the consumer as well as personal contact in buses to advertise various facets of service. The potential bus or train user must be capable of reading schedules, relating his transportation needs to available transportation routes, and identifying appropriate transportation vehicles. The individual consumer chooses certain modes of transportation on the basis of certain predetermined attitudinal sets.

"It was much pleasanter at home," thought poor Alice, "when one wasn't always growing larger and smaller, and being ordered about by mice and rabbits. I almost wish I hadn't gone down that rabbit-hole—and yet—and yet—it's rather curious, you know, this sort of life! I do wonder what can have happened to me! When I used to read fairy tales, I fancied that kind of thing never happened, and now here I am in the middle of one! There ought to be a book written about me, that there ought! And when I grow up, I'll write one—but I'm grown up now," she added in a sorrowful tone: "at least there's no room to grow up any more here."

—Lewis Carroll

C. Population Density and Proxemics

A crowded situation can be described as (1) filled with people or things; packed; (2) packed too full; (3) close together; inconvenient; lacking room. Psychologists to date have not completely agreed upon the definition of density but they have begun to converge in regard to research findings on the effects of density.

Population Density

There is a body of evidence that suggests changes in animal population due to crowding effects which are apparently caused by certain physiological changes. Certain pathologies appear (enlarged adrenals) and result in a decline in population growth whenever crowding exceeds a tolerable limit (25, p. 135-148). Consequently, one could define crowding as a parameter above which certain growth reducing pathologies begin to appear.

Other definitions have looked to interactive influences of space and organism reaction. Density can be defined as a lack of privacy. For example, we can distinguish three different degrees of privacy which include: (1) privacy of not being seen but heard; (2) privacy of not being heard but seen; and, (3) privacy of not

[3] Learned behavior refers to any behavioral change which is not due to maturation (genetic effects)

being sensed—not seen or heard. We structure our surroundings and our behavior to meet certain criteria of privacy. The living room serves a different privacy function than the bedroom or bathroom. Lee wrote that

> . . . through habituation and teaching the mother reproduces on the child her own needs, in this case the need for privacy which inevitably brings with it related needs. Now the child grows up needing time for himself, a room of his own, freedom of choice, freedom to place his own time, and his own life. He will brook no interference and no encroachment. He will spend his wealth installing private bathrooms in his house, buying a private car, a private yacht, a private woods and a private beach,

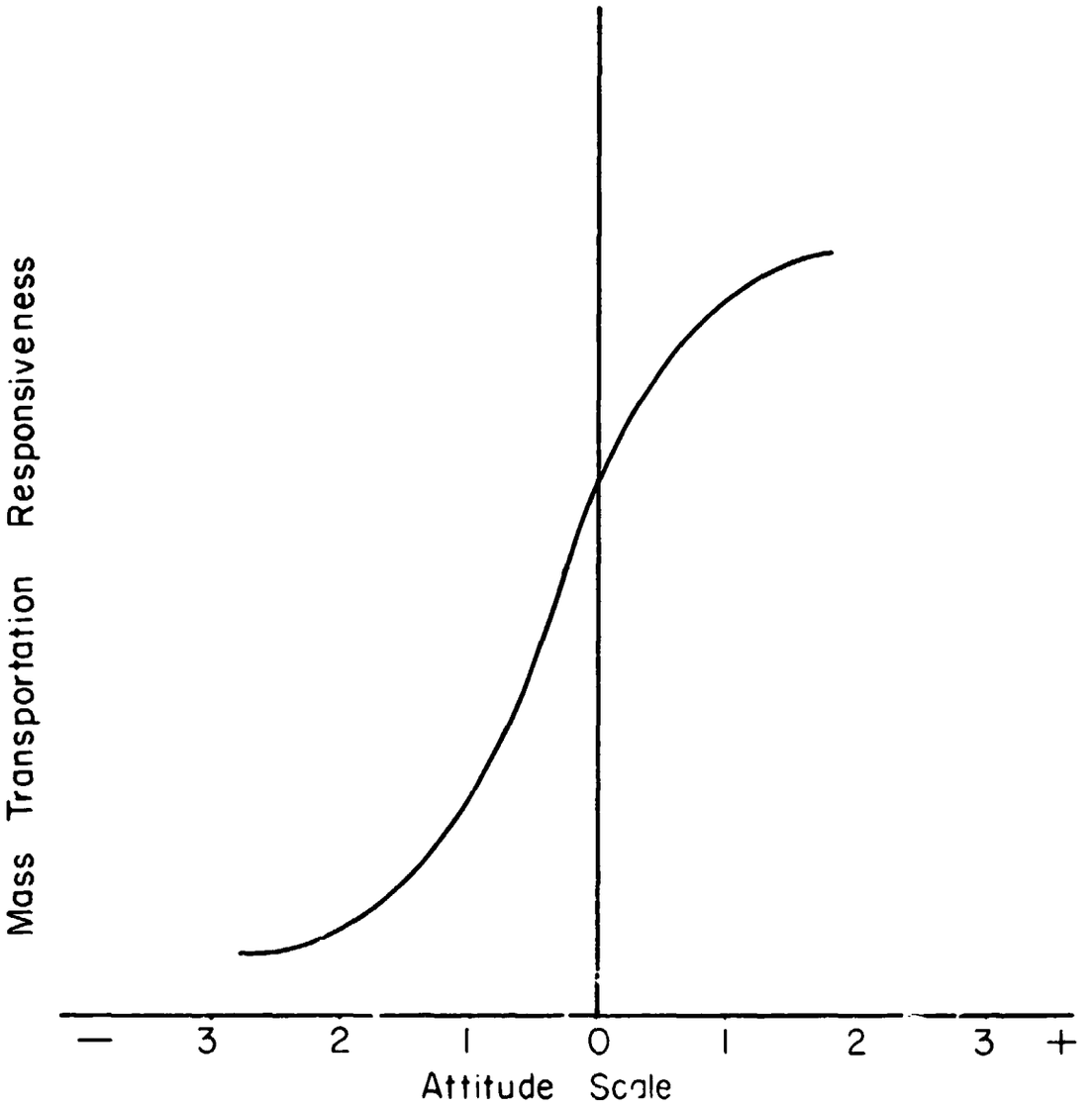


FIGURE 3-3
RELATIONSHIP BETWEEN ATTITUDE CHANGE AND MASS TRANSPORTATION RESPONSIVENESS

which he will then people with his privately chosen society (38, p. 77).

Deson (30, p. 79) suggested that density can be defined as a level of social stimulation in which "being crowded in receiving excessive stimulation from social sources." He hypothesized that subjects' perception of being crowded was contingent upon the overall level of social stimulation. He further reasoned that any structural change which reduces interpersonal perception should act to reduce social stimulation and concommittant feelings of being crowded. To accomplish this, design features were varied. Deson wrote that they

> ..included all of several absorbing materials for walls and ceiling, partitioning, minimizing the number of mirrors, doors, and windows that view "people spaces," maximizing the disparity between the linear dimensions of the space, use of low lighting levels and high non-social noise levels and any other feature that a designer can control which interferes with the transmission of stimulating energy within the space (30, p. 80).

The above listed design features were altered on scaled-down room models with student subjects placing small figures in the setting.

The experimenter found that significantly more figures were placed in rooms which were partitioned than those rooms which were not, thus supporting the original hypothesis. It was also found that more figures were placed in two door rectangular rooms than two door square rooms. It was interesting to note that size differences were not always clearly related to crowding. Further research is needed to identify maximally effective barriers.

"Tut, tut, child!" said the Duchess, "everything's got a moral, if only you can find it." And she squeezed herself up closer to Alice's side as she spoke.

Alice did not much like her keeping so close to her: first, because the Duchess was very ugly: and secondly, because she was exactly the right height to rest her chin on Alice's shoulder, and it was an uncomfortably sharp chin. However, she did not like to be rude: so she bore it as well as she could.

—Lewis Carroll

Proxemics

Edward Hall has written that "we treat space somewhat as we treat sex. It is there but we just don't talk about it (13, p. 40)." Proxemics, the stuoy of personal space, is closely related to problems which are associated with population density. Research has indicated that individual personal space is shaped by various structural configurations in which we find ourselves placed.

Sommer (6) found that social interaction patterns were related to different seating configurations. Certain seating arrangements were found to facilitate socialization by increasing both physical proximity and visual contact, while other arrangements were found to discourage socialization. It was also found that ratings of different configurations as "being very intimate and psychologically close" or "very distant" were not cross-culturally significant, nor were they found to differ according to sex (6, p. 64); Elkin (3, p. 64) found that children had similar perceptions of seating patterns although there were age differences present.

Tolcott studied seating behavior of individuals waiting for a bus at a station. He found that although benches were twelve feet long people in general preferred to sit at extreme ends with few individuals invading the "sanctity" of the middle territory. The author suggested the addition of arm rests which acted as a natural barrier and as protection of the personal body space (6, p. 65).

An inherent need to protect the privacy of the area immediately surrounding the body has been recognized. Loss of personal space has been found to increase stress and emotionality. Interpersonal distance was found to be an important factor in certain forms of psychopathology (35, p. 651-656).

Crowded situations are an invitation to possible invasion of personal spaces. Mass transportation as currently designed does not respect the right of personal space. Nor are few formal territorial boundaries utilized by designers to protect personal space. Most attempts to maintain privacy are informal social adjustments such as avoiding eye contact with those on the bus or reducing others on the bus to status of non-persons. Other defenses have been described by Sommer (6):

> Many subway riders who have adjusted to crowding through psychological withdrawal prefer to treat other riders as non-persons and thereby resent situations such as a stop so abrupt that the person

alongside pushes into them and then apologizes, then the rider becomes a person (6, p. 59).

Mass transportation, if it is to widen its base of appeal, must consider problems of crowding and personal space in design technology. It is conceivable to include, wherever possible, definite physical clues which would indicate the territory to be occupied by one individual. Variations in seating arrangements would accommodate various styles and degrees of socialization. Increased use of partitions would reduce the perceived density and increase ridership comfort. Improvements such as these would increase the number of riders who are not "captives" of any particular system and can choose with discretion the system which best meets their own individual needs.

Figure 3-4 presents a design of transit vehicle which incorporates many of the design features which have been previously discussed. One can note the variation of seating arrangements. Efforts were made in the design to reduce the amount of perceived crowding. Such design changes are a programmatic attempt to increase consumer acceptability and therefore increase ridership.

D. Personal Safety

Mass Transit ridership in many larger metropolitan areas has decreased due to fear of possible assault or robbery.[4] More effective measures must be employed to protect the security of the rider, if mass trasnportetion is to become a viable alternative to the car. A number of system design innovations have attempted to increase personal safety. Some of the more effective and pragmatic proposals include:

[4] As our early ancestors stayed within their walled habitats, so too do we stay locked in the relative security of our personal vehicle

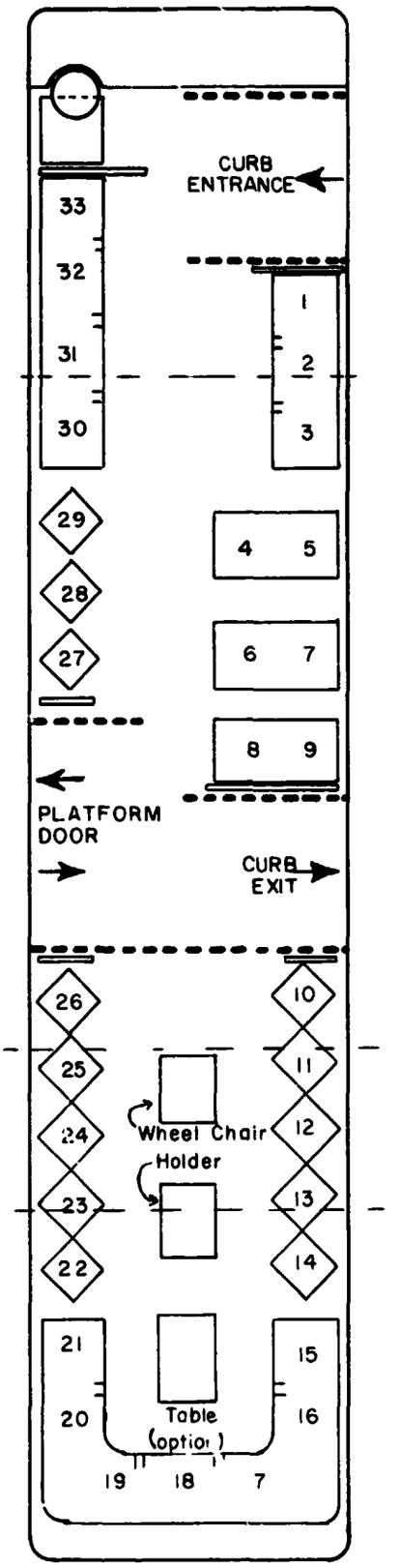


FIGURE 3-4
INNOVATIVE BUS DESIGN

REF: TARTA'S TOTAL SYSTEM, Toledo Area Regional Transit Authority, 1972, p. 26.

Use of automatic vehicle monitoring systems. The use of two-way radios or other communications devices on public transportation vehicles has proved effective in several areas. First it has been useful in detecting crimes in progress and thus more quickly apprehending the suspect: "His voice was picked up by a speaker—mike behind him, transmitted by radio to Bi-State Transit System headquarters—and a St. Louis police squad car pulled up and nailed the thief in about a minute (46, p. 21)." It has also been noted that two-way radio tends to reduce the feeling of "aloneness" which the driver may have on late night routes (40, pp. 387-389).

Increase stationary site security. Increased levels of light and limited visual obstructions are simple, but effective crime deterents. Use of transparent walls and partitions, where appropriate, can also add to security (8, Chapter V).

The number of visible telephones can add to the perceived security of the passenger. The use of alarm systems also serve the same function and should be considered in the design of stationary facilities.

Increased use of preventive patrolling by uniformed and non-uniformed police. "Preventive patrol—the continued scrutiny of the community by visible and mobile policemen—is universally thought of as the best method of controlling crime that is available to the police (18).

III. Substitutes To Transportation

In the past most efforts to "solve the transportation problem" have focused on increasing capacity rather than reducing the demand or need for transportation. Even today the emphasis is on a "balanced transportation system," i.e., getting people out of cars and onto buses, tracked vehicles, airplanes, or some other mode. While few would argue that decreased dependence on the automobile is not a worthwhile goal, the question to be asked may not be, "How do we provide an alternative to the automobile?" but rather, "how do we provide an alternative to travel?"

The reasons why people travel were touched upon in Chapter I. As an oversimplification, people travel because things are in the wrong place. Just how much of this spatial distribution of activity is necessary or even desirable is not clear. Changes in values, technology, and life styles have occurred and will continue to occur so that factors which were once important may no longer be important or will become less important. For example, an increasing portion of employment is in "information" areas rather than in "manufacturing."

On the other hand, it is painfully obvious to all that factors previously ignored now must dominate our thinking. In the past one could assume the availability of an almost unlimited supply of cheap energy. Tacit approval for industries to pollute was given by zoning regulations which said, in effect, "As long as you stay in the blue area on the map, you can make all the smoke and noise you want." Energy and environmental considerations have already become important and certainly will remain so in the future. While some technological breakthroughs will likely lead to modestly priced energy in the future, to plan for the future assuming a large amount of cheap energy will be unwise at best.

What then can be done in a society where vertical (social) mobility has become dependent on horizontal mobility—the freedom to travel? Transportation has often been viewed as providing opportunity—the freedom of choosing where to live, where to work, and where to shop. In choosing a mode of transportation, where a choice exists, trip time is generally agreed to be the most important consideration. While modal split studies usually assume cost as the only other important factor, studies have shown that convenience and comfort, among other things, are more important than cost. Privacy and personal control of one's destiny have also been shown to be very important. How then can the need to travel be reduced, while providing even more mobility, especially for those who lack it now? (See Appendix G)

This section will discuss three not entirely unrelated possibilities. First, by changing patterns of **land use** and directing expected **growth,** demands upon our present "transportation system" can be minimized while at the same time providing for **the right to walk to work.** Second, even with existing land use patterns, a reduction in travel demand can be accomplished using presently available—and expected future advances in communications—technology. Telecommunications could be effective specifically in substitutions for the "journey to work." Even if more "recreational and social" travel were generated, the added travel could occur at off-peak times while peak

period travel would be reduced. Third, factors relating to peak-load problems, such as staggered working hours, or three- and four-day weeks, are discussed. At this point one should note that many of those situations for which "shifts" could be staggered are the same ones where better land use planning and increased use of telecommunications could eliminate much of the need to travel.

A. Land-Use

In order to provide a large amount of "opportunity" that is relatively easily accessible to all, **clusters** of activity are desirable. To a large extent, the larger the cluster, the greater the opportunities. Unfortunately, as the cluster gets larger, accessibility to its opportunities becomes more difficult and often impossible. Present urbanization trends are likely to con-

tinue since a "house in the suburbs" seems to be part of the "American Dream" of many. Even if this were not the case, it is unlikely that our present densely populated cities could be rebuilt within a generation to accommodate very much of the nation's population growth providing an improved quality of life for all. The population of this country is expected to increase by about 50 million during the next 25 years. (7, pp. 842-845). Where will these people go?

While we try to reduce transportation demand, we recognize the fact that most people and their means of livelihood are in the suburbs. Around the ten largest metropolitan areas, 73 percent of the people work in the suburbs. Of all suburbanites in the ten largest residential regions, only six percent work in the central business district (21).

The basic national pattern of dispersing both jobs and homes is not likely to change much Suburban shopping centers, schools, churches, medical centers, light industries, community meeting halls, and information centers are becoming self-sufficient. The present trend is toward "omnicenters" where everything needed is close to home.

Reconstruction of the central cities does not appear so imminent as to reverse the trend. Although there have been a number of attempts at urban homesteading, e.g., Wilmington, Delaware and Philadelphia, this activity is not expected to increase the population in cities substantially. If some high density "superblocks" are developed and prove themselves successful (e.g., residences, jobs, stores, services, and recreation, contained in the same building or confined geographical area), central cities will begin to "hold their own" and support additional population in what many would consider a desirable way of life. In the immediate future, improved mass transit from the suburb to central city will work against this by making it easier for people to live outside the city.

Another possibility is the development of new cities designed to minimize the needs for transportation while providing desirable living conditions To accommodate all the expected growth, 50 new cities of one million each would be required by the year 2000. An optimistic estimate might be 25 new cities of 100,000 developed by the end of the century, providing for only 5 percent of the growth. A number of demonstrations with new cities are under way. Such activity should certainly be continued, although the immediate benefits will be somewhat limited. The long-range benefits include the possibility of perhaps 50 new cities of one million each in 50 years. Such cities could accommodate any population growth in this country during the 21st century along with allowing a redistribution of some of the population of the year 2000 (7, pp. 842-845).

A third way to provide for the population growth is the new "rural society," a large scale dispersal of people and jobs interconnected by sophisticated telecommunications systems. As our employment opportunities become increasingly information oriented, and as considerable technological developments occur, a substantial portion of the population could be accommodated in such a manner. While the interaction effects of human factors with large-scale use of telecommunications is unclear, this approach holds promise for the future. A more detailed discussion of telecommunications as a substitute for transportation is contained in a later section of this chapter.

The remaining place for growth is in moderately-sized metropolitan areas. Most of the growth is presently occurring in these areas and it will continue to occur there during at least the next 10 to 15 years and probably until the end of this century. In these areas immediate action is necessary to prevent development similar to that of present large metropolitan cities which is almost wholly based on private gain with minimal consideration for the public good. Continued development in the random and sometimes arbitrary way of the past can only increase problems which now exist

The evidence suggests that in many cases widening roads does not necessarily reduce congestion. After a short period of time the level of congestion in the improved highway approaches its previous level.[5] And yet, the major portion of our "transportation budget" continues to go into concrete, while most of the remainder is committed to "improvements" designed to perpetuate the cities of the past, i.e., rapid movement of highly skilled people from outlying areas to the central business district, near which is a large supply of low-paid, unskilled labor. The problem has been studied and restudied. New studies are proposed and undertaken. Most of them provide little, if anything, in the way of new ideas or information Often such studies are made to avoid, or at

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[5] The systems effects may be mixed The improvement may relieve congestion on parallel routes while increasing it on feeder and dispersal routes

least postpone, making decisions and taking action.

The need for large numbers of people to assemble five days a week from nine to five in a central location should be seriously questioned. Most industrial and commercial expansion is taking place outside of the central business district (21). In the 125 largest Standard Metropolitan Statistical Areas in the country—all those with a population of more than 250,000—the commuting picture looks like this: 36 percent live and work in the central city, 34 percent live and work in the suburbs, 18 percent live in the suburbs and work in the city, 7 percent live in the city and work in the suburbs, and 5 percent live in the area and work outside of it. In the ten largest SMSA's only 27 percent work in the central cities and only 6 percent of the suburbanites work in the central business district (21).

In most cities, new fixed-guideway transit systems which assume that everyone works in the same place or corridor, and that there will be increased density in the central business district, should be questioned. On the other hand, in a number of older and larger cities, rail service along existing tracks using rail-busses or light rail vehicles might be worth considering. New or expanding cities should consciously utilize new or existing tracks to direct their growth, rather than simply respond to it.

The approaches of the past—more and "better" highways—cannot be used in the future. In most urban areas, the provision of additional lanes or rights of way invariably requires something to be torn down. If it is businesses and stores, one eliminates the very need for coming to a city; if it is residences—the more usual case—one only increases the need for additional travel, and hence the load on the transportation system (positive feedback). Further, the use of the private automobile cannot continue to increase as it has in the recent past. This is clearly the case if one agrees that more highways are not the solution and recognizes further that energy and environmental considerations will severely constrain the use of the automobile. In fact, the amount of material needed to provide large numbers of any type of personal vehicle might better be used in other ways—housing, for example.

Planned Growth

In order to provide for the expected population growth, careful planning is necessary. An important realization at the outset is the unlikelihood of eliminating the need and desire for automobiles in this century—if ever. Even if all new growth and development could be planned carefully with high priority given to eliminating the need for autos, the random location of existing facilities almost requires their continued use. Wilfred Owen has noted:

> If the automobile is in fact undesirable, efforts to convince consumers have not been notably successful. In Europe, automobiles were long viewed unsympathetically by governments. Cars were heavily taxed, along with fuel, little was done to build and improve highways and parking facilities, and both rail and transit facilities were heavily subsidized to help them compete with the automobile. These negative policies were the opposite of the approach to the automobile in the United States, where taxes were kept low, highway programs were heavily subsidized, and transit and rail facilities neglected. The results have not been very different. Europeans adjusted by making smaller and more economical cars, by suffering higher accident rates and greater traffic jams, and by parking on the sidewalk. But they did not give up the idea of driving (16, p. 19).

The urbanization trend will not be reversed in the near future. New development will occur whether planned or unplanned. Owen argued:

> If unplanned, the difficulty of moving around will be magnified, the satisfactions of the urban community will be forfeited, and excessive resources will have to be devoted to traffic relief. The challenge is to assure that the location of housing, industry, and community services produce convenient arrangements that solve transportation problems instead of creating them (16, p. 68).

In the preceding section, four areas of growth were discussed: redevelopment of old cities, new cities, a rural society, and expansion of present urban areas. Development of new cities and expansion of present urban areas have as much in common as they have differences. The differences are mostly in scale. With new cities one is dealing with larger populations and entirely new services and utility distribution systems. However, even in the expansion of present urban areas generally ad-

ditional new distribution systems must be added although the amount may be considerably less than for a new city. In either case, it is useful to consider the European experience where "for many centuries (the countries have) been faced with a relatively fixed amount of land and a consequent need to work out socially sound land policies" (10, p. 2).

Today, almost all of the major European countries have comprehensive national legislation of land use. With no vast reaches of empty land to settle, both farmer and urbanite have developed a socially-oriented parsimony in the use of land and an insistence that settlements should be pleasing to the senses as well as conducive to human industry. Private property is an entrenched institution in all Western European nations and generally receives positive government protection. The bulk of lands held by the national governments are forest, lake, and mountain properties. On the whole, municipal government owns little vacant land and where there are exceptions, the municipalities have secured the land under advanced purchase programs. However, in the post World War II era there has been an increased emphasis on the public interest and greater exercise of public influence and control over urban land use. Apparently, there has been a growing realization among the European public generally of the need for public measures to control or guide the use of land (10, pp. 5-11).

Available cost data indicate that the infrastructure costs of urban extensions (satellite cities) or of the expansion of existing villages and towns are less than those required for redevelopment of the central city at higher densities. A number of studies suggest that per capita infrastructure costs of new cities with a population range between 40,000 and 100,000 are substantially less than those of larger cities (10, pp. 209-211).

Even in larger cities proper planning can lead to considerable savings. For example, in Milton Keynes, England, which is being designed for 250,000 people, five different urban forms were studied by a computer simulation to investigate the transportation requirements of each. The five designs were (1) concentrated central employment; (2) employment concentrated around the periphery; (3) a division of employment between the center and periphery; (4) two major employment centers at opposite locations on the periphery; and, (5) a dispersed pattern of job locations (16, p. 69). The results are shown in Table III-I. The "Dispersed Employment" pattern shows a significant advantage in "street lanes required" over all other forms without requiring much more than the minimum possible commuter travel.

Cities that focus on a single high-density urban center will inevitably have high transport infrastructure costs because the convergence of many people and goods means high-capacity, and hence usually high-cost solutions such as subways (16, p. 70).

Mechanisms for Control

Local governments with their limited boun-

TABLE III-I

TRANSPORT AND URBAN DESIGN
Milton Keynes, England

Urban Plan	Daily Passenger Miles of Commuter Travel	Total Street Lanes Required (miles)
Concentrated Center	268,000	340
Perimeter Employment	319,000	240
Mix of 1 and 2	290,000	220
Two peripheral centers	340,000	385
Dispersed Employment	272,000	170

Source: Wilfred Owen, *Automobiles and Cities: Strategies for Developing Countries*, Working Paper No. 5, Organization for Economic Cooperation and Development, Paris, August 10, 1973, p. 70

daries and generally insufficient funds cannot carry out land use planning in an entirely effective way. At the same time, detailed physical planning at the national level, and perhaps even at the state level, is unwieldly and lacks flexibility. There is a need for broad national goals to guide specific regional and local plans and programs.

Rapid price increases for urban land have made it possible for landowners to reap large profits from socially created values. These profits could potentially be used to finance much of the infrastructure costs of urban development. One means of coping with this problem is the advance acquisition of land reserves, enabling municipalities to control the future character and direction of land development, while retaining for the public interest the gains in land values. Another means is to impose additional capital gains taxes, and betterment levies on sellers who realize a substantial profit on land transactions attributable not to their own improvements but rather to public investment or other socially created values.

Europeans have generally recognized that the actions of free market forces alone do not often result in either a socially or economically desirable distribution of employment opportunities, primarily because the full private and social costs of various types of tax incentives, loan guarantees, and subsidies, as well as construction permits for new factories and office buildings. These steps have been taken in varying degrees, but generally efforts are uncoordinated and often work at cross purposes.

For some minutes Alice stood without speaking, looking out in all directions over the country—and a most curious country it was. There were a number of tiny little brooks running straight across it from side to side, and the ground between was divided up into squares by a number of little green hedges, that reached from brook to brook.

"I declare it's marked out just like a large chess-board!" Alice said at last. "There ought to be some men moving about somewhere—and so there are!" she added in a tone of delight, and her heart began to beat quick with excitement as she went on. "It's a great huge game of chess that's being played—all over the world—if this is the world at all, you know . . .

—Lewis Carroll

B. Telecommunications

In the mid-1970's the technological capability exists to transport information without the need to move people physically from one location to another. It seems increasingly more advantageous to use telecommunications equipment (telephones communications satellites, etc.) to reduce the physical movement of people and papers and thus ease the transportation demand.

Futhermore, as fuels and vehicles increase in cost, people will look for alternatives. The ubiquitous application of electronic technology will divert large numbers of individuals from highway networks into electronic mass communication networks. Telecommunications, to some extent, will partially substitute for transportation.

The Washington *Post* reported that the World is in a communications revolution (27, p. 36). The *U.S. News and World Report* called it a communications explosion (33, pp. 87-89). According to Field, a well-furnished electronic office of the future world include: computer terminals, graphic consoles, facsimile transmission, television monitors, picture phones, dictaphones, and automatic calculators (32, pp. 73-75). In the mid-70's, two-way television can be added to that list.

Werner von Braun wrote in 1973 that corporate general managers will no longer be required to come to headquarters for monthly meetings (48, pp. 68-71). Instead, each participant will sit before a three-dimensional color camera in his home office. Relayed by satellite, the images of all the others will be projected upon the curved wall of the booth, and their voices will be heard. All will have the feeling of being seated in the same room, around the same table (48).

A good example of using telephone lines to replace travel is seen in the NASA Viking Project Office located at the Langley Research Center in Hampton, Virginia. This office is responsible for the overall management of NASA's Viking '75 Mission to Mars. The numerous private contractors and several government agencies are located throughout the Nation, with a large percentage of the Project personnel time spent traveling to reviews, meetings, and conferences.

In order to save travel funds and better utilize the time of project personnel, the Viking Project Office in 1969 began a search for a suitable teleconference system. The desire was to use the telephone conference method for as

many meetings and conferences as practical (51).

Several teleconference systems were tried during the period 1969 to 1974, some of which were elaborate and expensive. Some provided a TV screen, some required a technician on hand to operate the equipment during the conference. One included a computerized data system. Most of the results were costly, complicated, unreliable; some were ineffective or restraining or excessively formal, but a satisfactory solution has been found—a modified Bell Telephone Company Model 50-A Teleconference System.

The modification consisted of replacement of the two accessory mikes of the 50-A unit with approximately six push-button type microphones plugged into a multiple jack. A portable mike if needed can of course be plugged into one of the jacks.

Gary Price (51) of the Viking Office indicated that the system is extremely reliable, simple to use, and costs only $30 per month for the equipment at each location. Direct Distance Dialing provides the connection. If illustrations are to be used for a teleconference, they are normally sent through the mail in advance of the scheduled event. Using voice communications along with the visual aids has proved to be very satisfactory.

As many as seven different locations have been connected to this system at the same time, with numerous people at each location, and very good results were obtained. As many as 70 people in a room have heard the sound signal from the one speaker with good reception.

The 50-A system can be used for formal or informal meetings in any location where there is a 4-wire telephone jack. The acoustics of the room are not important. The system is lightweight and easily portable. Only a few minutes are needed to set up the system.

The NASA Viking Project has a teleconference almost daily, with its own personnel or its contractors. As of July, 1974, there were fourteen conference rooms so equipped, six at Hampton, Virginia, one at NASA headquarters in Washington, one at the Jet Propulsion Laboratory in California, and six distributed among its contractors.

Price said the savings by reduced transportation have been "thousands and thousands of dollars, savings are so great we cannot calculate." He gave two examples of real savings: (1) On March 29-30, 1973, a major Critical Design Review was held in Denver; 24 people were sent there, but 35 remained in Hampton for the teleconference. A saving of $400/trip for the 35 people was realized. (2) On August 17-19, 1972, the Viking Office sent 16 people to Denver but kept 22 at Langley for another teleconference. The transportation savings for the total of 57 people who did not travel to the two meetings was $22,800 (51).

In spite of the fact that telecommunications will deliver all kinds of information into American homes—medical records and consultations, art and drama, a kaleidoscopic array of sports events, governmental events—many people argue that a complete conversation includes non-verbal as well as verbal cues. The satisfaction of participating in a folk dance, going to an annual banquet, or being in the stands at a sports spectacular to feel the fans' instantaneous response to the game cannot be duplicated or replaced by cable systems.

Concerning technical obstacles to two-way home television, John R. Pierce of the California Institute of Technology wrote in 1972 "As yet, there is not enough channel capacity in the cables to accommodate thousands of two-way TV conversations in homes." Futhermore, he indicated that the widespread use of computers is held up by lack of cheap, compact, reliable terminals (43, p. 30).

Field wrote "The most serious communication deficiency is the utter lack of compatibility between systems, devices, software, and formats for educational, computational and communications use" (32, p. 75). Arthur L. Robinson claimed "Problems such as the design of terminals for optimum man-machine interaction have yet to be solved" (45, p. 182). Douglass Cater of the Washington, D.C. Press Corps indicated that with too much communication, there will be an information overload, the quality of TV will be diluted, and with transducers everywhere there will be too much invasion of privacy. He declared that "feeding" the new communicating systems, i.e., providing satisfactory information on them, will be a great deal more costly than building the hardware (20, pp. 37-39).

Few people are considering the cost of electronic hardware as an impediment to two-way TV communications in the home. The research will be expensive but it will be spread out among many millions of customers and it will be a small part of the household cost.

One of the brighter characteristics of the communications trend is that electronic devices are not very expensive and do not require much energy. Frank Coss, executive vice

president of an advertising agency in New York City has written:

> While the costs, direct and indirect, of transportation vehicles and fuel and the construction of transportation facilities, such as highways, move relentlessly upward, the electronics industry has demonstrated consistently an ability to develop sophisticated, compact, low-cost equipment. Adopting electronic commuting—teletransportation—could well serve as a catalyst to bring about desirable changes we cannot achieve while harnessed to conventional transportation, the magalopolis, the necessity to earn to be mobile and be mobile to earn. In particular it could be the first major move toward reducing, rather than continuously expanding our consumption of energy and raw materials. And for the long term, it could signal a shift in our social and economic goals to give human values priority over those of the machine. Implicit in the concept of teletransportation is the potential for a new kind of social structure: an electronically interconnected, physically dispersed society (27, pp. 41-42).

Jack Nilles of the University of Southern California computed that "Use of the private automobile costs about 25 times as much energy as telecommuting" (15) in intraurban situations. His computation even included the energy losses in the electric generating plants. Field said costs will not be a barrier to the tremendous increase in telecommunications (32, p. 73). At the present time, the cost of home color TV is only two or three cents per viewer message. Some long distance phone calls are much less expensive than they were even a few years ago; the cost of coast-to-coast voice circuits by domestic satellite is only one-third of the cost by land routes (26, pp. 37-39).

There have been several examples of improved efficiency and reduced per-capita costs of services through telecommunications, where in each case there was a reduction in transportation demand. In the field of education, impressive technological advances have been applied. They are also evident in the areas of electronic banking, printing, shopping, and office and secretarial services.

Already one can see a psychiatrist at a distance through TV, and get consultation on-the-spot. This is done from Logan International Airport through a link with Massachusetts General Hospital in downtown Boston, Dr. Thomas Dwyer, the program's director, said,

> I can work with a patient as I would in my office. There is the same give-and-take, and, most unexpected, the same sense of intimacy. I continue to be pleasantly amazed at how well the system functions. Even when a prescription is needed for perhaps a tranquilizer, I just write it out for the nurse and it appears instantly at the airport's medical station (42, p. 18).

Yet, some psychiatric patients seem to feel safer at a distance, preferring the protective barrier of the TV screen. Others feel a stigma is attached to a face-to-face visit with a psychiatrist. Dr. Dwyer reported that none of the psychiatrists on his roster considers the TV medium inadequate.

The FCC ruling in 1968 that the nation's telephone network must be opened up to the use of equipment provided by other than the phone companies themselves has already changed communications greatly. For example, MCI Communications Corporation uses microwaves to join major cities for business accommodation. In only 20 months, MCI has captured 80 percent of the Bell System's private-line service between St. Louis and Chicago. It was done mainly by undercutting prices. Subscribers are provided private service anywhere along the network for phone calls, date transmission, facsimile and closed-circut television signals (44, pp. 73-76).

Communications competition is getting more intense. New office buildings have all kinds of phones and equipment that are not owned by the phone company. Nationwide firms, even some with foreign offices, are linked together by privately owned equipment, using only Bell's long-distance facilities. "This is only the beginning," said Booz, Allen, and Hamilton, management consultants, "even clerical and secretarial functions and the way we use physical facilities such as business offices, will change dramatically" (44, p. 76). Von Braun wrote that the almost unlimited capacity of comsats will finally transform picture phone service from an expensive luxury into a popular-priced amenity of everyday living (48, p. 70).

Douglass Cater said in October of 1973 that when the new technology is implemented, home information centers will be capable of

printing out the daily newspaper even while viewers watch the latest rerun of "I Love Lucy." Connected to a computer, even the Library of Congress can be brought into the home (26, pp. 36-40). Inexpensive transistor radios have brought instant news from the far corners of the Earth to every nation; home information centers extend this information explosion. With several public education TV channels available in every home, and with teachers at hand with a push of a switch, one will be able to listen to lectures, pay a small fee to take the examination, and receive academic credits from his choice of educational institution near or far.

Robert Jastrow, in the New York *Times* on June 10, 1974, was reported as saying by 1980 a New York-Tokyo conversation by color TV could be within every businessman's reach. He said communications satellites will permit people to live where they please regardless of their work; concentrations of corporate headquarters, and publishing, banking and legal services in and around large cities will not be necessary. Every house will be transformed into an office, theater, or classroom by pressing a few buttons. Communications will tend to reverse the growth of the city. Mr. Jastrow predicted that communication satellites will cause a slow but irresistible dispersion of mankind, and that the megalopolis may go the way of the dinosaur (37, p. 6).

Lawrence H. Day of Bell Canada, in a 1973 prediction, was not quite so optimistic. He said that by 1985 twenty percent of our homes will have two-way television; by 1990 twenty percent of our homes and neighborhoods will have remote work centers (29, pp. 509-510).

Von Braun said "letting the electrons and microwaves do the travelling will become the fashion of the eighties" (48, p. 69). Arthur Robinson said telecommunications can improve the medical situation for the sick and injured using two-way circuits including EKG's and X-rays. Nurses or paramedics in outlying clinics can receive instructions from the physicians (45, p. 267). In other words, there will be telemedicine too.

How will teletransportation as a replacement for conventional travel change the employment situation? Though home and neighborhood communication centers will substitute for many of our trips to schools, offices, banks, sports events and theaters, and visits to friends, there will still be need for performance of skills and delivery of commodities—perhaps a greater need than ever before. The service industries, especially those providing goods and facilities into the neighborhoods, will increase. There will be more emphasis on human services and electronic services where people live. We will still need food, clothing and shelter, the production, delivery and maintenance of which will keep millions of people employed.

It is likely that transportation activities by the year 2000 will constitute only ten percent of our gross national product instead of 20 percent as they do now, but the 10 percent difference will be replaced by additional services, some of which will be convenient teletransportation services.

C. Staggering Work Hours and Week Days

There may be justification for providing incentives to encourage employers to adjust starting and quitting times by staggering work hours. At the very least, public policy could bring about changes in the working hours of government offices. A substantial reduction in congestion already has been achieved in several cities by this method. For example, staggering the work hours of 4,500 New York City employees resulted in a 9 percent reduction in the peak volume in lower Manhattan subway stations. Further, the maximum number of passengers waiting for elevator service in one big office building dropped from a peak of over 110 to less than 40 (17, p. 48).

As an example of how much the peak capacity requirements of a transportation system might be reduced by staggering work days, consider Table III-II. This table starts with the assumption that everyone works Monday through Friday and no one works on weekends. (While this obviously is not true it is satisfactory for the purposes of illustration). If this same work force were distributed over six days with one-sixth of 17 percent not working each day, the transportation system capacity required could be reduced by 17 to 83 percent of that required for a 5-day schedule. For the arrangement shown it would not be possible for everyone to have a two-day weekend. Most people would have one day off in the middle of the week. Using all seven days, the capacity required could be reduced to 71 percent of that for the 5-day schedule. Considering social and religious attitudes in the United States, a 7-day schedule with some variation in the percentage working each day probably would be more desirable. Indeed this is the present work distribution. One possible such schedule is given in the Table III-II showing a 15 percent reduction in required peak capacity.

TABLE III-II
HOURS SAVED STAGGERING WORK HOURS

5 - DAY WORK WEEK							
Schedule	Percent of Work Force Working per Day						
	S	M	T	W	TH	F	S
1. 5-Day	—	100	100	100	100	100	—
2. 6-Day	—	83	83	83	83	83	83
3. 7-Day	71	71	71	71	71	71	71
4. 7-Day Varying	30	85	85	85	85	85	45

4 - DAY WORK WEEK							
Schedule	Percent of Work Force Working per Day						
	S	M	T	W	TH	F	S
1. 4-Day	—	—	100	100	100	100	—
2. 5-Day	—	80	80	80	80	80	—
3. 6-Day	—	67	67	67	67	67	67
4. 7-Day	57	57	57	57	57	57	57
5. 6-Day Varying	—	50	75	75	75	75	50
6. 7-Day Varying	28	62	62	62	62	62	62

3 - DAY WORK WEEK							
Schedule	Percent of Work Force Working per Day						
	S	M	T	W	TH	F	S
1. 3-Day	—	—	100	100	100	—	—
2. 4-Day	—	—	75	75	75	75	—
3. 5-Day	—	60	60	60	60	60	—
4. 6-Day	—	50	50	50	50	50	50
5. 7-Day	43	43	43	43	43	43	43
6. 5-Day Varying	—	45	70	70	70	45	—
7. 6-Day Varying	—	30	60	60	60	60	30
8. 7-Day Varying	30	45	45	45	45	45	45

If the work week were to be reduced from five days to four, very large reductions in transportation system capacity required could be achieved (Table III-II). With everyone working a four-day week, but with work distributed equally over seven days, the transportation capacity requirements would be only 57 percent of those needed when everyone works the same days. Even with some variation in the daily work force, requirements could be less than two-thirds presently required. This would allow for a 50 percent increase in population without requiring an additional transportation infrastructure to maintain the present levels of service.

Reducing the work week to three days (Table III-II), would cut the required capacity in half. This could allow the transportation infrastructure to accomodate the expected increase of population for the rest of the century and eliminate the most severe congestions during peak hours at no additional cost.

These are possibilities that deserve further attention and careful thought. For example, most people might prefer to have all their days off consecutively rather than having one off in the middle of the week and one or two on the "weekend." The date in the examples above are meant to convey only that sizable reductions in required peak capacity that might be achieved by staggering work days. A detailed study should be made by any organization contemplating such a change before implementing it since the advantages and disadvantages to both the employer and the employee—as well as the society as a whole—will vary considerably from company to company.

"Tickets, please!" said the Guard, putting his head in at the window. In a moment everybody was holding out a ticket: they were about the same size as the people, and quite seemed to fill the carriage.

"Now then! Show your ticket, child!" the Guard went on, looking angrily at Alice. And a great many voices all said together ("like the chorus of a song," thought Alice) "Don't keep him waiting, child! Why, his time is worth a thousand pounds a minute!"

—Lewis Carroll

IV. Theoretical And Practical Cost Considerations

As noted in Chapter I, the criteria for urban planning can seem subjective in nature. In this section both theoretical and practical cost considerations will be discussed in an attempt to provide an objective basis for altering the choices that have led to our current transportation problems.

A. Social and Private Cost

In Chapter I, there was a brief discussion of the requirement that transportation planners should have an ability to choose a preferred plan. If the planner is choosing for a group, or if there is a group of planners who must jointly choose a plan, a problem arises in defining *desirable* social (or, in the context of this report, urban) changes. If different individuals prefer mutually exlusive goals, how can these goals be chosen which maximize social well-being? Despite its obvious intuitive appeal, a simple-majority voting rule does *not* guarantee a "best" outcome (1).

For instance, a major metropolitan problem has developed, in part, as a result of the inadequacy of the simple-majority rule. As the metropolitan area became populated by a majority of low income families, this majority used its voting power to increase the tax bill of the higher income families. The minority group of higher income families, feeling overly oppressed by this trend, began moving out of the inner city into the suburbs. This exodus eroded the tax base of the central city to the extent of leaving it almost incapable of solving its own transportation problems.

If the simple-majority rule does not insure a social "optimum," what alternative is available? The only non-subjective planning rule which could be adopted is the **unanimity rule** (1). If **all** persons agree to change, then it is difficult to argue that the change is not a desirable one. All persons are very likely to agree to a change if it is a so called **Pareto** change, one that makes at least one person better off while making no one worse off (with both "better" and "worse" determined by the affected party).

Any change which would help at least one person and hurt no one ought to be made. Actions undertaken by an individual which affect only him ("private actions") will be unopposed by other individuals; that is, individuals in our society might unanimously agree not to intervene in totally private activities.

The problem is, of course, that totally private actions comprise only a small subset of all possible actions. An action by an individual that provides benefits or imposes costs on other individuals is an action exhibiting *externalities* or *spillovers*. Positive externalities are

benefits provided while negative externalities are costs imposed. If individual A's action imposes a cost on individual B, then B will likely oppose A's action. Whereas private actions can be left (by unanimous agreement) to the individual to decide, actions involving externalities are not as simple to handle. Because unanimous agreement is not possible, we face the dilemma of measuring and comparing gains and losses for different individuals. If A thinks he gains from an action and B thinks he loses, what criteria are possessed to determine if A's gain offsets B's loss?

This problem can be eliminated if **side payments** are allowed to be made. If individual A gains from his own action while causing individual B to lose, and if A gains more than B loses, then A can afford to compensate B for his losses (e.g., make side payments). That is, A can buy B's agreement, unanimity prevails, and we have avoided the necessity of interpersonal comparisons. Side payments, together with a decision rule of unanimity, insure that all changes will be "socially desirable."

Some socially desirable change, however, will not take place due to the bargaining costs involved in determining the amount of side payments. For instance, suppose A wished to take an action that would yield $10 worth of satisfaction but would cost B $5 worth of satisfaction. Suppose further, that A cannot act without B's approval. A can afford to pay B up to $10 for his approval, while B will insist on at least $5. There is a range of $5 which must be determined by bargaining and the cost associated with coming to a decision might be high (if it is thought to be more than $5, then A will not take the otherwise socially desirable action).

This argument is illustrated in Figure 3-5. On the vertical axis both the external cost of actions taken under less than unanimity rules and the costs of getting agreement under various rules are measured. On the horizontal axis, the percentage of individuals required for action (the voting rule) is represented. Under a rule which would allow each person to make decisions for the group, external costs would be high but decision-making costs would be low. If unanimity were required, the external costs would be high. Social welfare will be maximized when the cost of social interaction (the sum of decision-making and external costs) is minimized (point D in Figure 3-5). The optimum decision-making rule would seem to fall somewhere in between the two extremes.

So long as transportation was viewed as a private consumption good, there was general concensus that it needed no governmental regulation. With few automobiles on the roads, there were few, if any, external costs. Air pollution was not a problem since the air has a natural capacity to absorb some amount of particulate matter. Neither was congestion a significant problem. Since there were no spillover costs from the use of transportation vehicles, there was implicit (no objections to private decisions) unanimous agreement that the choice of mode be left to the individual (1, pp. 94-96).

Today, **transportation can no longer be considered a private activity.** There are external or spillover costs involved with the choice of transportation modes which the individual typically does not take into account. These include, congestion costs, environmental pollution, and energy depletion costs. Since spillover costs are involved, either side payments with unanimity, or a decision rule which will minimize the cost of social interaction is desirable. This, by requiring that producers of automobiles attach anti-pollution devices to their cars, the externality (pollution) is being internalized—the individual automobile user is forced to pay to eliminate the externality, thereby converting automobile use to a totally private good as pertaining to pollution. Internalization of externalities converts "public" actions to "private" actions.

B. Actual and Perceived Costs

An important principle of welfare economics states that resources are allocated efficiently when the price of each good or service is equal to the full marginal resource cost of producing it. As pointed out in the previous section, the divergence between private and social costs will lead to a misallocation of resources. Less recognized, but perhaps equally important is the fact that differences between actual private cost and perceived private cost are in some cases substantial.

A basic function of prices is to discourage consumers, with their limited income, from buying goods and services. While this may seem contradictory to observations that merchants attempt to set prices to encourage consumers to buy particular goods, it is not. Viewed in isolation, the price of a single good (service) constrains purchase, since, if only that good were purchased, the consumer could buy only a finite quanity (given by the consumer income-price relative). Absolute prices do not guide consumer choice; relative prices do. When more than one good (service) is considered the consumer compares different prices and

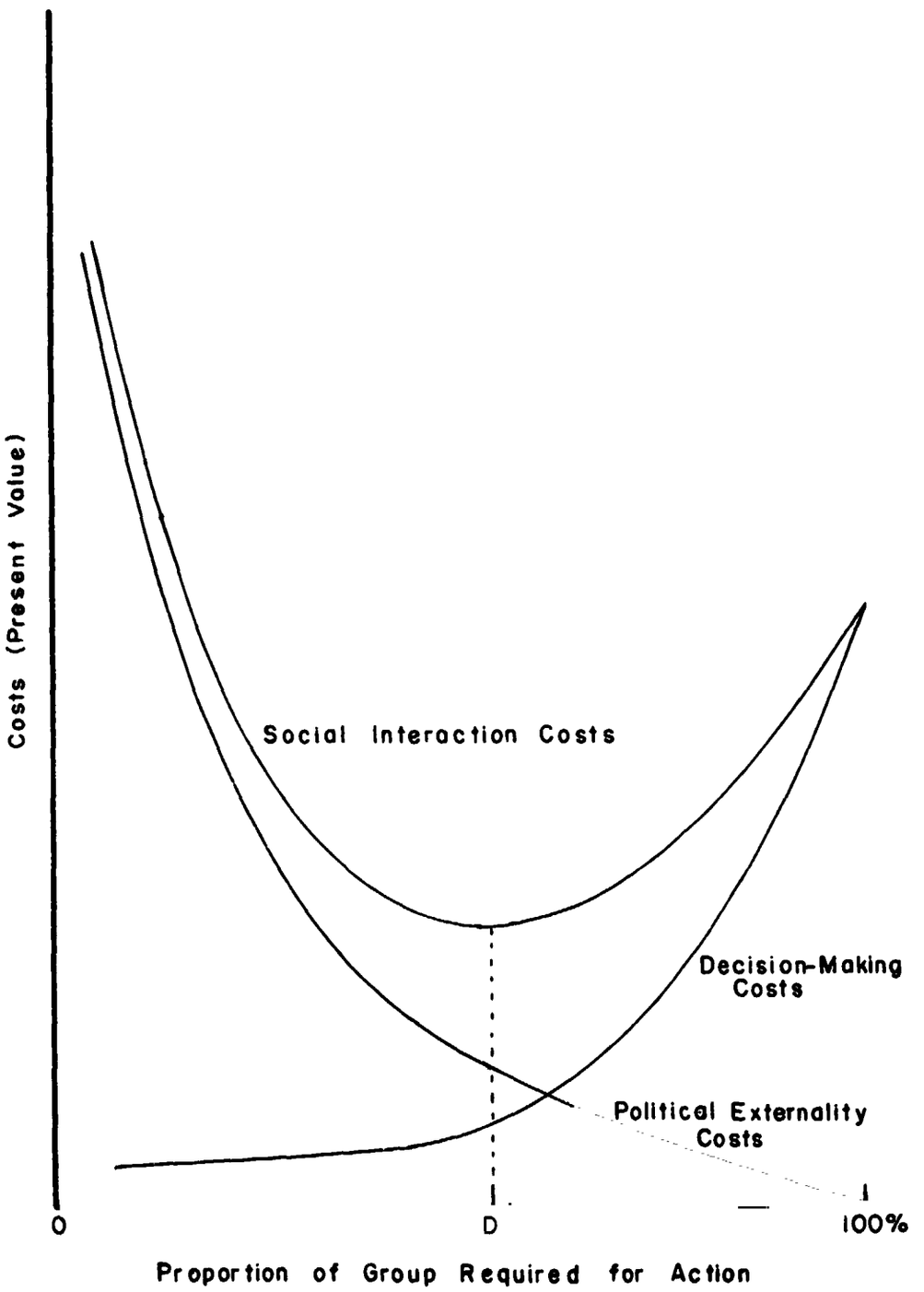

FIGURE 3-5
SOCIAL INTERACTION COSTS

different amounts of expected satisfaction or utility with respect to the different goods (services). Consumer sovereignty allows the consumer to spend his limited income by choosing among goods (services) on the basis of the expected cost (price) to the consumer relative to the expected satisfaction from the good. Consumers select by calculating and comparing among a wide range of goods; quite simply, what they pay (or expect to pay) is compared to what they get (expect to get).

What is the price of a good? For many items the answer is straight forward; it is stamped on the box or jar, written on the menu, printed on a tag, or quoted oraliy. For a wide variety of purchases, however, price is illusory and/or invisible. What is the price one pays for a kilowatt of electricity, last night's three hours of television, or this morning's trip to the supermarket or bank? It is difficult to estimate cost on items like these because they are not directly priced.

If prices are invisible they are perceived in many cases to be zero. Almost invariably, the perceived level is below the actual level. In all cases where the actual price exceeds the price perceived by the consumer, from the standpoint of economic efficiency, too much of that good will be produced and consumed. Excess consumption and production of a given good implied, generally, insufficient consumption and production of at least one of a set of close substitutes. Hence, even if price equals marginal resource cost—the usual norm—resources will be allocated inefficiently if for any good, the real price or expected benefits are illusory.

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At least implicit recognition of the foregoing argument underpins important recent consumer legislation and administrative directives (e.g., truth-in-lending, unit pricing for grocery retailers, and buyer's remorse laws protecting buyers from door-to-door salesmen. There are precedents for dealing (legislatively, judicially, or administratively) with resource misallocation stemming from divergence between perceived costs and perceived benefits.

A case for public intervention in private modal choice can be established on similar grounds. Consider the choice between driving and taking a bus from point A to point B. Is there a diversion between actual and perceived cost? The cost of taking a bus is manifest.[6] The full fare is perceived as cost. The actual cost of driving an auto has been estimated at between eleven and eighteen cents per mile depending upon specific operating conditions. A popular figure is 15c per mile which includes all capital and operating costs. At the moment of choice the perceived price of an auto trip is much closer to zero. One group of motorists, in response to a questionnaire, reported, on average, a perceived cost per mile of only five cents.[7] This, of course, is a false signal leading most likely to excessive automobile travel.

C. Cost Modification

The two preceding sections have been a discussion of divergence among **perceived private costs, actual private costs,** and **actual social costs** of transportation (See Figure 3-6). Although determination of the precise benefits and costs of transportation modes in quantitative terms is difficult, some examples might be given to suggest the magnitudes involved. Since autos contributed 73 percent of the unburned hydrocarbons, 73.6 percent of the carbon monoxide, and 61.2 percent of the oxides of nitrogen pollution in 1970, one might conclude that similar percentages of the costs created by these effluents should be allocated to automotive travelers (17). In the case of traffic jams, one famous study of auto congestion in urban areas suggested that "something like the lower limit" of charge justified by congestion costs would be 2.2 cents per mile (6). From these two illustrations alone there is apparent justification for some steps toward ending the artificially low level of perceived private costs.

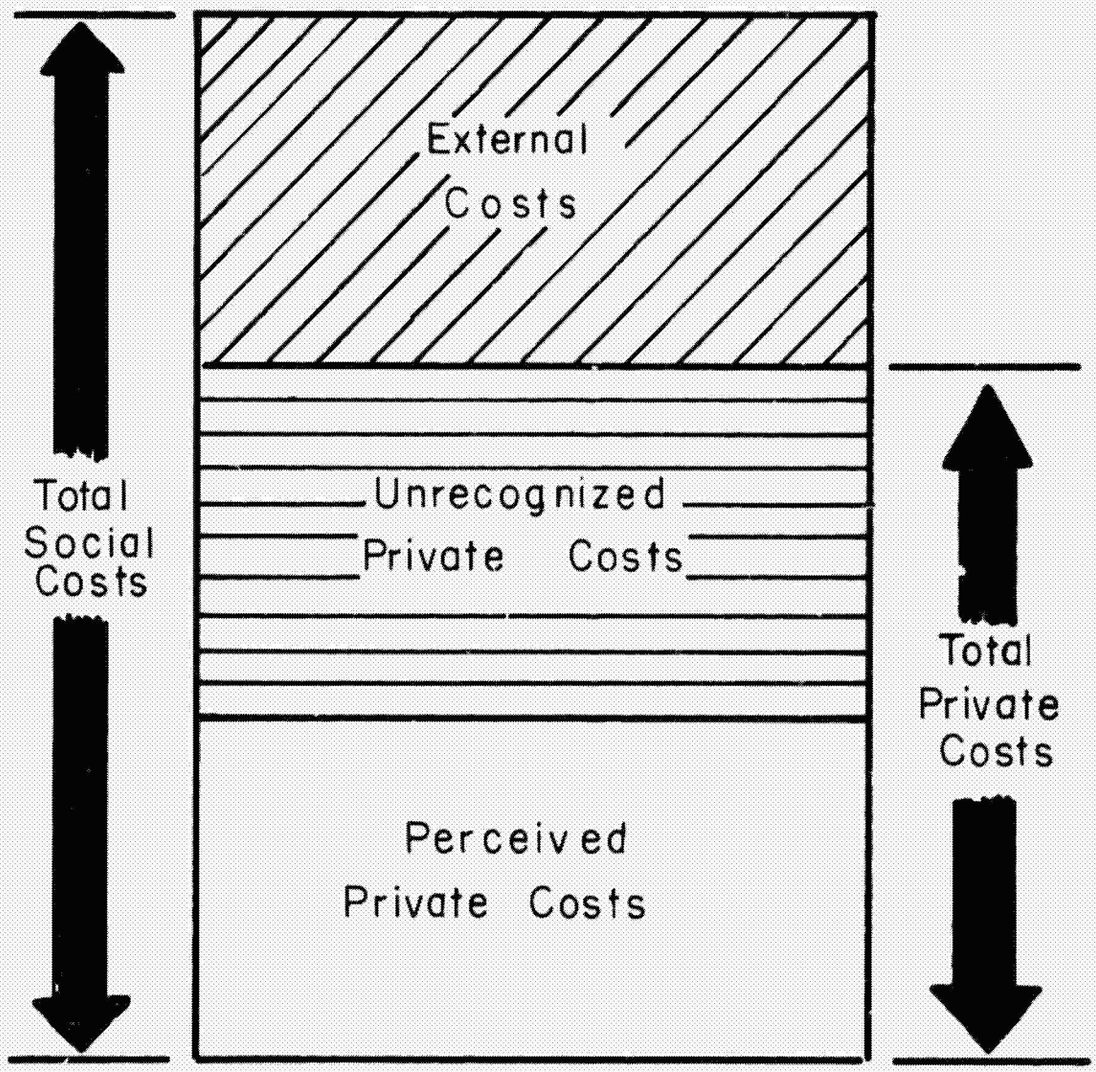
If there are likely to be advantages from

[6] The real **short run** cost of taking the bus will be greater than the fare (the cost perceived by the rider) if the bus company is subsidized from public funds to enable it to cover operating deficits. The real **long run** cost of a bus trip will not be reflected in fares if capital subsidies are made

[7] See Appendix G

clarifying the consumer's perception of auto traveling costs and discouraging trips, one is still faced with the problem of how to go about altering the cost structure. The remainder of this section will deal with some suggested institutional changes which might accomplish this task. The major topics to be examined are (1) methods for dealing with the fact that perceived private cost is below actual private cost; (2) techniques for correcting the biases which exist in modal choice due to the **spillover** costs not borne by automobile drivers; and, (3) some

FIGURE 3-6
COMPONENTS OF TRANSPORTATION COSTS



tools for getting at the specific problem of "peak-load" utilization of transportation facilities. In each case the lists of ideas should be considered as **examples** of the types of action which might be taken, rather than exhaustive inventories of all possible strategies (See Figure 3-6).

The first area for consideration is the problem of cost perceptions. Most people neither realize how much their car is costing nor that costs are a problem. One approach to make costs salient might be an increase of information to drivers. Cost per mile could be stressed in driver's education courses. However, since this information would decay over time, there is a need for continued reemphasis. Just as the federal government has taken action to force tobacco companies to remind their customers of the health hazards of smoking, perhaps auto makers or some other organization (like DOT?) could be used to remind us of the harmful effects of driving to our pocketbooks. The Environmental Protection Agency has already moved in this direction by requiring mileage figures (mpg) to be given for cars produced after 1973. This could be extended to a statement of total costs per mile on the design life of the vehicle. Another innovation might be a statement of the dollar costs of operating the vehicle between safety inspections. Along with the bill for the inspection, garages could compute the total driving cost by checking the previous and current odometer readings, indicating the cost per mile and multiplying the difference in mileage by the cost figure.

Even more impact from expanding information could be achieved if automobile cost information were included along with information on other modes. For example, **when actual costs of auto operation are presented, there could also be an estimate of** what the same amount of travel would have cost if the driver had used **presumably less costly public transit.**

As a minimum step toward facilitating efficient consumer choice, one might advocate expanding **promotion of mass transit.** The consumer is constantly bombarded with image-building automobile advertising which contains little useful information. Buses and other forms of mass transit should be advertised as a sensible way to travel locally.

While all of the above suggestions might help to clear up cost misconceptions, a somewhat radical proposal has been suggested which might be even more effective. Transit riders have long been exposed to the full costs of their trip because the fare included some allocation of both fixed and operating costs of the system. One way to give drivers an analogous view would be to install coin boxes which had to be fed before the car would operate. Even if these coins could be recovered periodically for maintenance, repair, and/or replacement of the vehicle, the reminder of these other costs at the time of travel might very well have an impact on modal choice. Currently, the possession of a credit card and a large gasoline tank can obscure the actual costs of trips, let alone the capital costs. Smaller gas tanks, cash only for gasoline and coin boxes make the transit fare look far less objectionable.

The list of suggestions could be extended indefinitely. But the purpose of the discussion is not to propose the best corrective strategies; rather, it is to indicate some of the types of things that might be done and to inspire others to think of still more and better ways to approach the problem.

The problem of inadequate and incorrect information is related to the further problem of spillover costs. Together they imply that there is too much use of cars from a social point of view. Attacking one source of bias toward cars will affect the other. The relationship of the two issues—information and spillover costs—can easily be seen by focusing on the means of handling the latter problem. As noted, drivers impose more external social costs on society than do transit riders. An increased use of mass transit will enable travelers to perceive and respond to a figure closer to both the actual private and full social cost of their actions. This should lead to a more efficient allocation of scarce resources.

How one goes about reducing the use of cars relative to mass transit vehicles depends upon determining whose rights are most legitimate—the auto driver's or the transit rider's—as well as a consideration of practical difficulties in bringing about changes. When external or spillover costs are created, efficiency gains are obtained either by charging people the full costs of their actions when they drive or by bribing them with the amount that a behavior change would be worth to society (when they ride buses). The values of society indicate which approach should be taken. As a practical matter, however, the changes in individual behavior may be best brought about by using both the carrot and the stick, i.e., society might combine incentives for desirable behavior and penalties for behavior which is deemed to be undesirable.

There are **four basic variables which should be controlled** in order to optimize efficiency gains: (1) amount of traveling; (2) choice of mode; (3) choice of route; and, (4) choice of peak versus off-peak timing of journeys. Even if external costs are not being considered, there probably is too much travel. It follows that taking account of these spillovers probably will reduce the level of travel. The choice of mode may be altered to increase use of more efficient modes. Similarly, the choice of route and, as indicated previously, the timing of the journeys should seek to avoid congestion during peak hours.

What are the types of actions which might be taken to reduce social cost—the third type of institutional change recommended? The following suggests a number of **strategies** and relates them to the kind of changes that each is inclined to produce. One approach to alleviate spillover costs is to expand information on them in a manner similar to the suggestions given earlier for increasing awareness of actual costs. Advertising promotion might be useful in bringing about behavioral changes in transportation mode choice; however, even if people know about the overall problem, they will perceive their personal role as irrelevant. The one area where significant progress might be made is to give **accurate** and **timely information** on routes which avoid traffic jams, thereby aiding people in making prudent choices This may help to reduce some congestion.

Since additional information seldom brings home the realization of external costs created and passed on by a specific individual, a second strategy might be to make these **charges** apparent. An individual can be charged for the explicit quantity of pollution his car produces. Such a "smog tax" may lead one to travel less and/or select different modes which create less effluent discharge damage.

Third, charges could also be used to make people pay for their contribution to **congestion.** For example, electric devices could be installed which must be charged in order to run the car. The device-charging process could be done for a fee, and the unit would discharge according to a rate determined by congestion-activated external signals in the street.

Fourth, one can conceive of a time in the future when a **coin-operated meter** (in addition to being used to enable a driver to perceive his actual costs) could also be used to levy pollution and congestions charges. Again, vehicle external signals could be used to determine the payment required to allow the car movement. This immediate meter payment could be followed at a later time by payment to the tax collector. Thus, the individual would be reminded constantly of the full social costs of his driving. This could bring about desirable changes in amount, route, mode and timing of travel. While the sophisticated electronic system described here is not presently an available choice, indirect methods can be used; e.g., taxes on gasoline can be shown to be very efficient means of attaining improvements in congestion and the environment.

A fifth tool directing behavior is **pricing** to direct traffic to specific routes, to make peak-hour traveling more expensive, and at the same time, to discourage travel by encouraging use of other transit modes. One unfortunate element of federal highway policy is that the interstate highway system is striving to eliminate tolls. This seems ill-advised in light of the usefulness of such charges in making drivers aware of the full social costs of their driving.

Sixth, an indirect method of levying charges to reflect external costs is **parking taxes,** set at a high level to discourage the use of cars while encouraging bus patronage. Futhermore, they could vary according to levels of congestion (and pollution) in different areas, and be higher for peak hour arrivals and departures. Such variation could direct the trip patterns and their timing toward more socially desirable configurations.

The purpose of the above measures is to raise the consciousness of individual perceived costs to reflect full social costs. Although many people may pay the charges and behave the same way, these measures will change travel amount, mode, route, and timing. The use of private cars with one or two riders is apt to decrease and utilization of mass transit should increase.

Seventh, another way of getting a similar result may be to use **incentives** (rather than charges) to bring about the desired results. Since there are less externally imposed social costs when people share rides in some form of mass transit, most incentives should be used to encourage multiple ridership.

A policy which could lead very quickly to efficiency gains is providing incentives for car pooling If half as many cars were used to get everyone to work, then both congestion and pollution problems would be cut at least in half. Providing an exclusive, uncongested freeway lane, special parking privileges, or even monetary payments to get people to share rides

would bring worthwhile changes in urban transportation conditions.

Rather than leave these advantages of shared rides solely to car pools, transportation policy-makers probably should advocate the increased use of more traditional forms of mass transit, such as the more efficient use of taxi cabs by allowing shared rides. Slightly larger bus vehicles and improved dispatching could be used, especially in off-peak periods, to operate a demand-responsive mass transit system. Even the traditional 40-passenger bus could aid in attracting passengers if it were more comfortable, safer, and more convenient.

Chapter II has already pointed out the advantages of more flexible bus service. The incentives suggested here and in the earlier discussion to induce riders onto mass transit will probably have to be financed publicly. If there are external or spillover costs from private autos, the public will benefit from reducing them. Moreover, there are added benefits of more efficient use of petroleum and other scarce resources.

Throughout this and earlier sections of this chapter, we have been examining changes which can be made to overcome existing transportation problems. The emphasis has been on institutions, land use, communications, and the human aspects of design, rather than the traditional concerns of transportation hardware. Clearly, there are many more things that can be done to improve movements of people and goods.

V. Some Legal Considerations

The following discussion of three legal considerations related to modifying institutions to cope with transportation problems focuses on institutional changes which would make more efficient use of transportation resources.

A. Labor

First, the greatest expense of urban bus operation is labor. One way of combatting the ever-increasing cost of labor is to use transit employees during the off-peake passenger hours, when so many buses stand idle. This might be accomplished by operation of **dual-use vehicles** to carry passengers during the two work-related travel peaks, and parcels during the remainder of the day.

An initial consideration is **franchising.** Parcel freight companies have been successful and should be presented with the opportunity to provide both parcel freight and passenger service. While a parcel freight company already has certification for its present activity, to operate the dual-use vehicles described above, it would need to acquire a bus franchise. Local parcel freight carriers might be encouraged to compete to acquire the failing bus company's franchise, with the understanding that the city would coordinate both the franchise transfer and any necessary efforts to acquire federal capital grants under the Urban Mass Transportation Act of 1964 (52) for the purchase of the special vehicles required.

There does not seem to be any legal barrier to such a plan; quite likely, the idea simply has not been tried before. It is commonplace that the governmental power to grant franchises is directly tied to a public need for the service in question; if adequate service is already available, legislation and local regulation will generally preclude issuance of a franchise. Obviously, where a bus company's operation is ending, a parcel freight carrier could show a public need for the passenger side of its offered dual-use service. Finally, as a regional example, a survey of the Virginia Code and of the Codes of the cities of Hampton and Newport News, Virginia, revealed no express prohibition of dual-use of common carriers for freight and passenger transportation (although their apparent assumption is that the two are generally mutually exclusive).

"That's the most important piece of evidence we've heard yet," said the King, rubbing his hands; "so now let the jury—"

"If any one of them can explain it," said Alice, (she had grown so large in the last few minutes that she wasn't a bit afraid of interrupting him), "I'll give him sixpence. I don't believe there's an atom of meaning in it."

The jury all wrote down on their slates, "She doesn't believe there's an atom of meaning in it," but none of them attempted to explain the paper.

"If there's no meaning in it," said the King, "that saves a world of trouble, you know, as we needn't try to find any . . ."

While a proposed dual-use vehicle system may not be precluded by franchising requirements, the operation of section 13 (c) of the Urban Mass Transportation Act (52, 1609 (c)) may pose a restraint in that its employee protection provisions might be used by the bus driver's union to prevent implementation of the plan. A

representative of the American Transit Association, indicated in an interview that the ultimate labor obstacle to dual-use service lies in the "protection" of territory by the Amalgamated Transit Union, with the concurrence of the Teamsters. For example, when questioned about the implications of transferring bus franchises from failing bus companies to freight companies, he answered that the Transit Union probably would not allow it; its disapproval of such an action would be honored by the Teamsters, who must maintain friendly national relations with their brother union.

This possible inter-union opposition to franchise transfer must be distinguished from the Transit Union's interest in protecting jobs jeopardized by the assumption of private bus companies by local governments. The latter is dealt with by section 13 (c)'s requirement that before federal assistance is extended "protective arrangements" must be made for "the protection of individual employees against a worsening of their positions with respect to their employment."

Thus, while section 13(c)'s purpose was to protect jobs and the status of their holders (52), and not to give workers additional bargaining power to defeat transportation programs in the public interest, nevertheless the union can be expected to attempt to utilize section 13(d), if need be, to prevent loss of union members.

While transit workers' opposition to transfer of their former employer's bus franchise is an understandable reaction and may protect their jobs, it does not necessarily protect the **total** number of jobs in transportation (e.g., transfer of the franchise to a freight mover rather than a quasi-governmental bus authority might **increase** the total number of transportation jobs, given that the private freight firm is more likely to run a combined service's passenger segment more efficiently than the present, struggling private bus firm).

In summary, utilization of dual-use vehicles is suggested as a means of overcoming the revenue per unit of labor cost problem. Potential labor opposition has been discussed; as the operator of the dual-use system probably will need capital assistance from the Urban Mass Transportation Administration to purchase the necessary vehicles, section 13(c) of the Urban Mass Transportation Act might serve as a lever which the bus drivers' union would use to prevent establishment of such a system. The union's opposition would result from the Teamsters' probable acquisition of members at the Transit Union's expense.

It is recommended that the development of dual-use vehicle systems be evaluated. If these are found to be beneficial, but subject to local unions' effective opposition in the manner outlined above, then the Secretary of Labor should announce that the Department of Labor's policy (62) against national labor union's manipulation of statutes for advantages those statutes did not intend will also apply to the locals.

B. Prohibition of Vehicular Travel

Second, unlike dual-use vehicles, city streets are a "transportation resource" already ingrained in civilization. Blanket prohibition of vehicular traffic has frequently been suggested as a possible solution to the urban congestion problem.

There has not been a significant number of cases deciding the nature of municipal power to prohibit outright vehicular traffic from city streets. Apparently, for various reasons municipalities have used their *regulatory* power, rather than any power of prohibition, to deal with urban traffic congestion.

Indeed, **no statute or case has been found upholding a municipality's right to prohibit traffic.** In *People v. Grant* (53), the New York court struck down an ordinance forbidding "all through or transient vehicular traffic" in a designated area in or near a village and evidently having no purpose other than to reserve the streets in the area for the benefit of the residents against the large number of employees of a nearby plant. Significantly, the court pointed out that no arterial "through" highway or substitute was designated; nor was it shown that any physically suitable alternative route existed which could be so designated. Therefore, the ordinance was held to be an unreasonable exercise of the power to regulate traffic and was in excess of local power. This decision indicated that if traffic had been totally banned from the community, affecting all citizens equally, such a measure would likewise be invalid, as no alternative route could be provided.

This view was expressed in dictum in *People v. Francis* (54), where the court stated that the ordinance in question was not interpreted to mean that a special license was required to use the streets because of the particular type of vehicle the defendant had used: "If that were so it might well be an unconstitutional law restricting a certain class of vehicle from the use of the town roads" (54, p. 487).

The court in *People v. Verity* (55) was explicit in holding a municipality has no power to prohibit traffic except as might be granted by an

enabling act: "Neither a town, nor a village has the absolute power to exclude vehicles from its streets. Whatever powers municipalities have in regard to regulating the use of streets by trucks must be found in the powers delegated to them in the vehicle and traffic law (55, p. 589).

The Montana court in *Carey v. Guest* (56) expressed the above limitation of municipal power to that contained in the applicable state enabling act in the following dictum: "We hold the city of Helena has the power to regulate but not to prohibit speed and traffic on its streets" (57, p. 241).

Thus, that power generally delegated to municipalities to regulate traffic is limited to regulation, and without express delegation of power to prohibit, public streets must be kept open. Further, the state enabling acts may indicate no general power to prohibit is intended to be delegated; e.g., Virginia Code section 46.1-180 provides the local political units may "regulate the operation of vehicles," while section 46.1-181 provides that trucks may be prohibited (except for the purpose of receiving loads or making deliveries on certain designated street(s) or restricted to certain streets when such trucks are in through traffic. Thus, the Virginia legislature implicitly limited municipal power to prohibit traffic; no power to prohibit automobile traffic was delegated, nor was the power to prohibit trucks a blanket one—i.e., even where streets are generally closed to trucks, trucks having business on such streets are not to be prohibited from using them.

A treatise on Virginia law makes explicit what may be the underlying philosophy of the Virginia enabling statute:

> The streets and highways belong to the public. They are built and maintained at public expense for the use of the general public in the ordinary and customary manner. Municipalities, as arms of the state, have absolute control over the streets in the interest of the public. Municipal authorities, as trustees for the public, are charged with the duty of keeping the streets open and available for public use. Under the police power, they may lawfully regulate the conduct of those using the streets, so long as legislation to this end does not abridge the constitutional liberty of persons rightfully upon the streets (57).

The constitutional limitation(s) on the power of state legislatures to delegate prohibitory power to municipalities is beyond the scope of this section; however, *Hague v. CIO* (58) indicated that the Supreme Court views public use of streets *per se* to be a constitutionally protected right. *Hague* held that the titles of streets and parks have been in trust immemorially for use of the public as a part of the privileges, immunities, rights, and liberties of citizens, and may not constitutionally be infringed by municipalities through the enactment of ordinances containing unreasonable regulatory or prohibitory measures.

In summary, there are significant barriers to the use of municipal power to close streets as a method of relieving urban congestion. This is particularly difficult where the effort is merely to close particular streets without making some other use of them (e.g., malls); the materials surveyed deal primarily with this question, and, *a fortiori*, indicate that wholesale closing of the streets of a city or its central area would be even less likely to be sustained.

C. Congestion Effects

While the philosophy that streets must remain open may lend substantial support to a theory of right to transportation, it flies in the face of using traffic prohibition as a governmental tool to ease or end congestion. In a word, *before municipalities can generally prohibit traffic there must be a fundamental rethinking of the public right to use streets.*

Third, an institutional change which would indirectly affect the use of transportation resources would be a requirement that landowners, particularly business, consider the congestion effects of their decisions; if an employer were required to pay to the city upon adding employees to his downtown office, he may decide he cannot afford to make the addition under the circumstances, or that he should move to the less congested suburbs.

The most apparent difficulty with this mechanism of controlling congestion is that it would be extremely difficult to implement. How, for example, can congestion effects of adding a certain number of employees to a firm's downtown offices be accurately measured? Further, any measurement would, of course, have to be updated periodically to reflect the changes inherent in operation of a business entity.

Special assessments might be used where congestion has necessitated a public improvement; in such a circumstance, the special assessment is imposed on property receiving special benefits from the improvements (59, p.

199). It is questionable that the mere possibility of public improvements and accompanying special assessment would have significant impact on business decision-making. A (necessarily sophisticated) public policy statement (e.g., by ordinance) would sharpen the edge of anticipated assessment upon those contributing to congestion; if an employer knew that the addition of employees to his office would practically assure a level of congestion in excess of the established volume, then he would have to weigh the probable expenses of the assessment for improvements to meet the congestion problem. It should be evident, however, that this method may be ineffective where the problem is most severe; if congestion is already at a critical level, the improvement of streets, for example, would be useless where there is nothing but sidewalk between office building and street.

A locality might attempt to use its taxing power to deal with congestion generated by firms. It is argued that the difficulty here lies in the institutionalized concept of taxation, the key element being the view that either taxation must be uniform (as is required generally by state constitutions) or that if it is not (i.e., it is "special") it "is lawful and constitutional only when founded upon special benefit accrued from the improvement for which the tax or assessment is laid" (60, § 38.02).

Thus, an exaction from an employer to be used for public transportation generally rather than a specific improvement uniquely benefitting those taxed, "would not be an exercise of the taxing power, but an act of confiscation" (60).

VI. Conclusions

Since it seems evident that the automobile will continue to be an important part of our transportation system, it is advantageous to modify automobile use to better meet the population's needs and desires while reducing its demands upon the world's resources and environment.

In the recent past, efforts have been directed to building more—more vehicles, more highways, more tunnels, and more bridges. These "solutions" have not really solved the transportation problem and have in fact, generated additional problems. The automobile is hungry. It gobbles land with substantial portions of our urban areas devoted almost exclusively to the automobile. It gulps energy, accounting for over one-third of our petroleum consumption. It fouls the environment of the total annual emission of air pollutants, the auto accounts for almost two-thirds of the carbon monoxide, almost half of the hydrocarbons, and over a third of the oxides of nitrogen.

This chapter has presented a look at demand modification and modal choice. A number of possible "software" proposals have been suggested for reducing our need for transportation and, in particular, our dependency upon the automobile. Ways in which better use can be made of existing transportation facilities have been discussed at length. These suggestions are not meant to be all inclusive. Nor would they all be appropriate in all urban areas. They are meant to indicate the range of alternatives to more automobiles which are possible.

While there is a very real need for travel, the individual's choice of mode should not work to the detriment of society as a whole. **Greater consideration must be given to human factors in future transportation planning.** The automobile currently meets the perceived needs of consumers while mass transit does not. Most mass transit is perceived as being unsafe, crowded, and uncomfortable. **Attitudes** such as these toward transportation are the result of conditioning and therefore subject to change. For example, one of the reasons the automobile is the dominant mode today is the amount and type of advertising by the auto industry. Contrast this to the relative lack of advertising for rail and buses. It is clear that transit vehicles must be redesigned to make them more compatible with the perceived needs of the users and potential users.

Rider **education** programs in the public schools are needed to complement the driver education programs now in existence. Considerable Federal and state funds are used to perpetuate the role of the automobile while too little funding is directed towards making mass transit systems safer and more convenient for the general public.

A number of substitutes for travel were discussed in this chapter. Particular emphasis was given to land-use planning to **manage** change rather than to accommodate it. Unless **land-use** planning and **transportation** planning are closely coordinated and used effectively to control the directions of growth, the transportation problem can only get worse.

Telecommunications offers another possible substitute for travel. Emerging technologies in two-way cable TV and videophones could cause a reduction in the need for travel. The savings in time, energy, and out of pocket cost can be considerable when **telecommunications** is substituted for travel. How much substitution

occurs will depend to a considerable extent on the cost and flexibility of terminal facilities.

Existing transportation facilities could be more effectively utilized. Most of our ground transportation systems are designed to handle the peaks caused by the journey to and from work and is grossly under-utilized the rest of the time. **Staggering** work hours and work days could relieve most of the **congestion** problems which occur today.

Another means to reduce the peak-load problem, as well as influencing modal choice in general, is to eliminate, or at least reduce, the difference between **actual costs** of driving an automobile and the user's **perceived costs.** A number of methods for accomplishing this were discussed ranging from increasing the amount of information provided on the total actual costs—both to the individual and to society—to requiring the automobile user to pay the total societal costs resulting from pollution, congestion, and depletion of resources.

The last section of the chapter deals with the legal considerations involved with some of the institutional changes proposed. In particular, possible **labor** related problems in combining passenger and parcel delivery services are discussed. Then the powers of municipalities in **regulating and prohibiting** vehicular traffic are examined. Finally, the possibility of a **"congestion tax"** on employers adding facilities in a crowded area is examined.

There is no single simple solution to the transportation problem. Chapter III has touched upon a number of different alternatives to meeting this problem which accumulatively could lead us out of the present quagmire of congestion and pollution into the Elysian fields of planned urban living.

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TRANSPORTATION AND DECISION-MAKING IN TIDEWATER

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Chapter IV

TRANSPORTATION AND DECISION-MAKING IN TIDEWATER

I. Introduction

The question of who actually makes policy decisions at the local and national levels has generated a great deal of controversy. Some social scientists, led by C. Wright Mills (9) and Floyd Hunter (6), have proposed a pyramidal structure of power in which an elite few (the "power elite" in Mills' terms) in key positions in government bureaucracies, corporations, the military, universities, and private associations form an interlocking and informal power directorate and control the key institutions of society. The decisions of this power-elite are then legitimized by being processed through second level elites who are elected or appointed officials. In this view, the masses of people are seen as powerless, and the traditional concept that the United States is a pluralistic society wherein power is diffused through counterbalancing interest groups is denied (Figure 4-1).

Critics of the conception of a power elite consider the theory to be flawed because there is lack of evidence of interlocking directorates which establish unified policies, and because it is unlikely that one can discover a central core of decision-makers who control policy directions in general: it is more likely, some critics believe, that different groups or individuals will have influence in one policy area but not in another. Proponents of the argument that a diversity of decision-makers is the prevailing pattern adhere to the pluralistic theory that group competition, not unity, characterizes decision-making at both the local and national levels.

There is no central conception of pluralism, however, that encompasses various arguments about diversity among decision makers (Figure IV-I). John Kenneth Galbraith's theory of countervailing power considers big labor, big business, and big government as all having sufficient power to veto policies considered detrimental to one or the other interest, but pluralism is not seen by all advocates as requiring veto power (27). Seymour Martin Lipset, and other sociologists, for example, view competition between groups in decision-making as inducing compromises that maintain the stability of society; no veto power over the proposed policies is required to maintain stability (7). Pluralistic theory holds that political resources are divided, and that no group has a monopoly over all resources. Pluralists agree that only small numbers of people participate directly in decision-making, but they contend that these few compete for economic rewards, differ on policy, are of open membership, and are influenced by voters.

Pluralists have come under increasing attack, however, because of the failure of governments to provide for all interested groups to participate in decision-making. It is evident that all groups or interests are not equal in resources, expertise, or access to decision makers. Without the assumption of equality of power the pluralist theory of decision-making can hardly be verified. Once the requirement that a veto is necessary for the protection of group interest is also relaxed, possible empirical verification of pluralism as the way decisions are made is also diminished.

In discussing decision-making in transportation, **neither** power-elite nor pluralistic theories are, in themselves, adequate to describe and explain how decisions are determined, changed, or implemented. Highly unified groups with great political power have been able to determine policies for highway goals and routes in the past without having to consider inputs from other groups. In recent years, there have been successful movements by citizens' groups in stopping highway routes, both in urban areas (8, p. 182) and outside urban areas (33). Hence, the process of decision-making in transportation policies has taken on more pluralistic characteristics. When dealing with transportation overall, the process still remains neither of the pure power elite nor pluralistic type. Lupo, Colcord, and Fowler have summarized the interest groups involved in implementing new transit programs:

> Ironically, the key supporters of major, that is, rapid transit improvements are almost never the operators, the users or even the direct beneficiaries of construction expansion programs. (In this respect, too, the policies of transit differ greatly from the policies of highways.) They are the CBD business community and the central city government. Their objectives are not transportation improvements; they seek what might be called spinoff effects, namely strengthening the downtown, discouraging further decentralization of middle class residences, rebuilding the tax base (8, p. 209).

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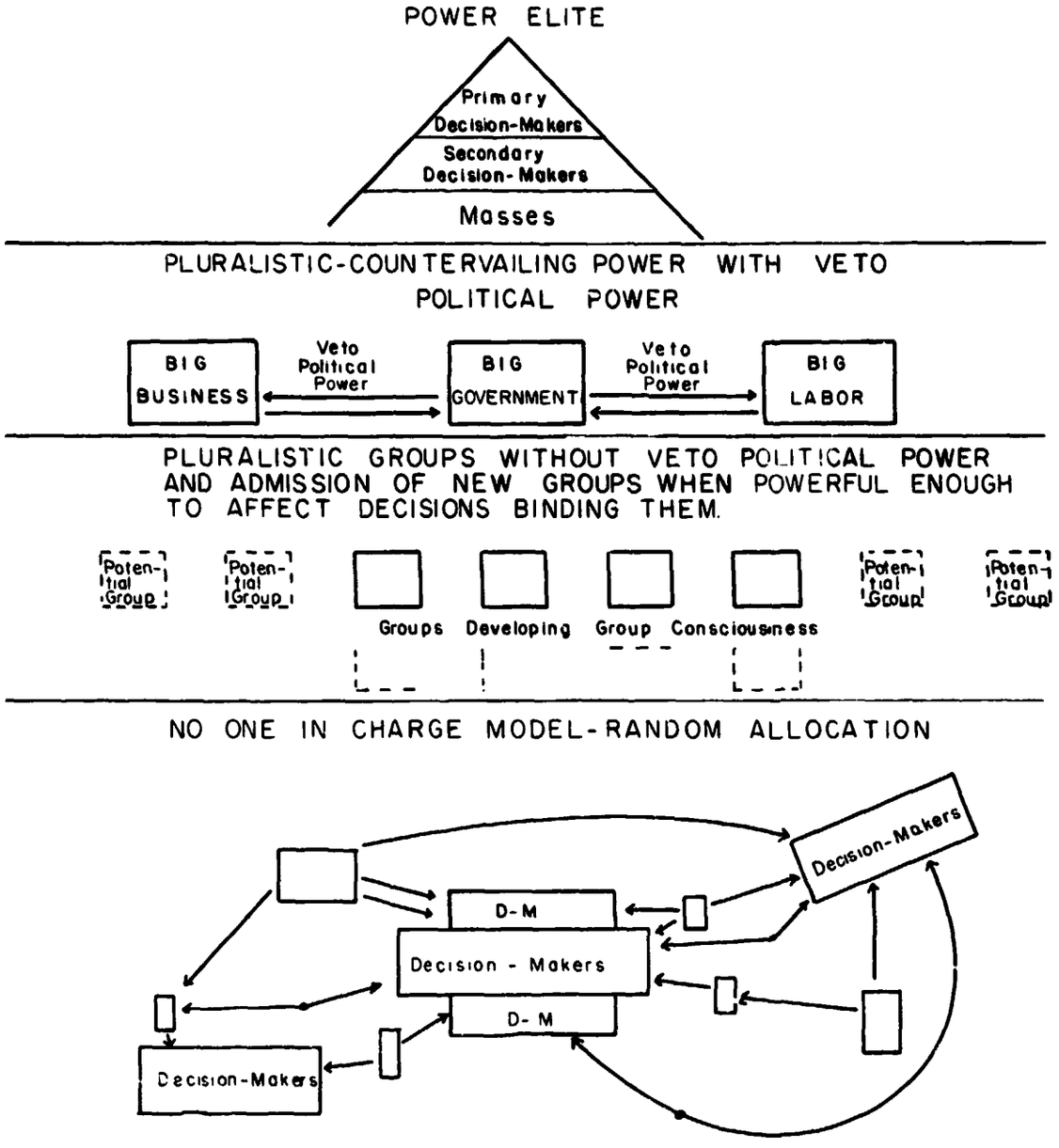


FIGURE 4-1
POWER ELITE

While the user inputs usually are not directly included in transportation decision-making in most cities there is a recognition that if mass transit is to be accepted—regardless of the reasons for proposing it—users and citizen's inputs must be given major consideration. While civic and business groups, planners, and politicians must provide the impetus for instituting new programs, users and citizens who have to support the system must be consulted, or at least the decision-makers must be open to consultation. Given the fact that power elites cannot implement transit policies in the same manner as they can in, for example, build-

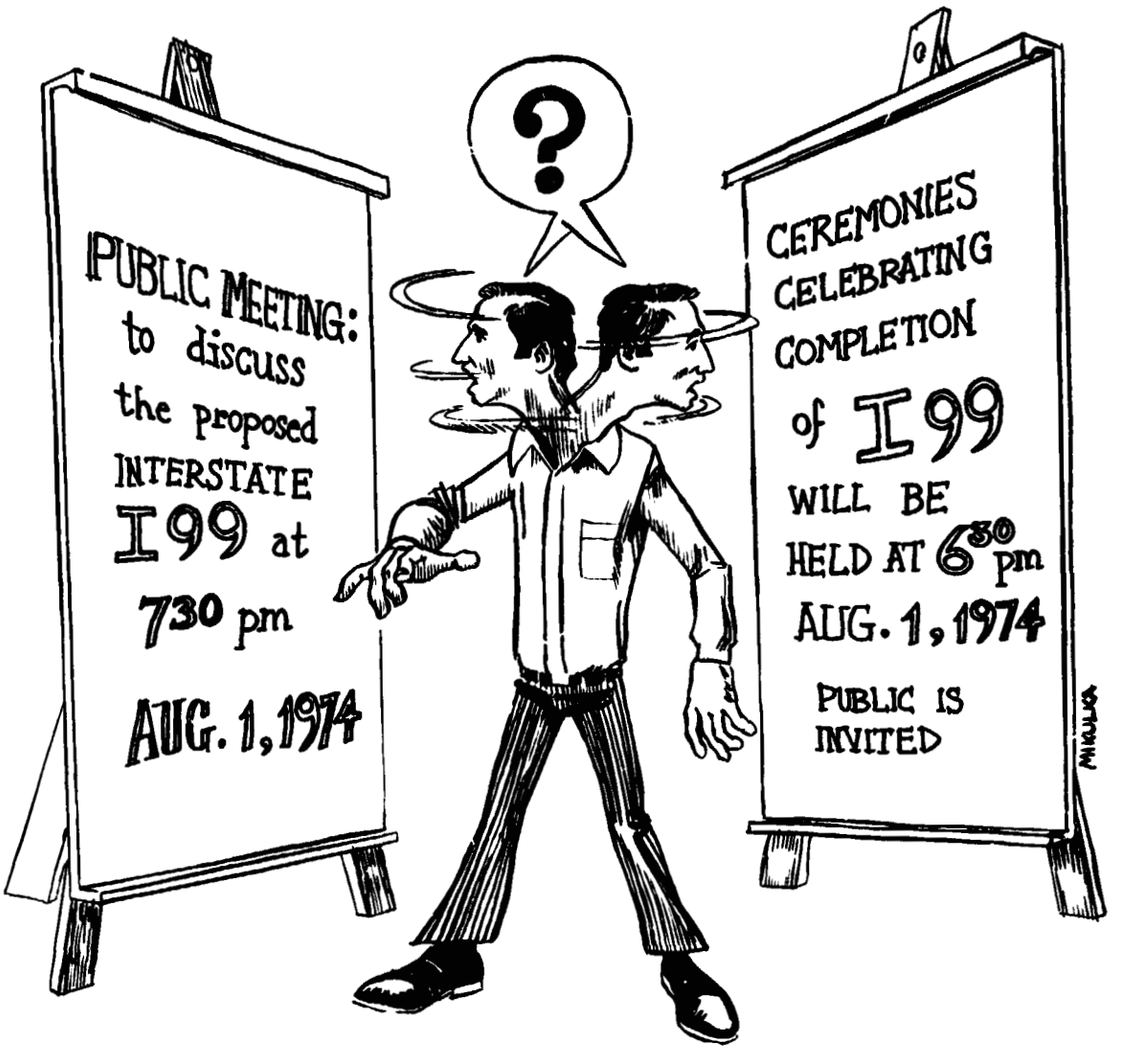
ing stadiums, and the fact that elected politicians are more involved in making mass transit decisions than in making other kinds of decisions, transportation policies have the potential for including more pluralism in decision-making than do many other policies—health care, for example—in most cities. A major reason for this is that transportation is seen more as a problem than as an asset by many powerful interests, and hence, the power groups controlling various parts of policies in other segments are willing to leave the solution to elected officials and the groups with an interest in mass transportation, providing that the costs to other interests are not too great.

Cincinnati, Ohio can be used to **illustrate** how power-elitism works to isolate citizens who pay the taxes for public health care and the users of the Cincinnati General Hospital from having any control whatsoever over hospital policies or practices (43). Cincinnati General is owned by the city, but is operated under a five-year contract with the University of Cincinnati Medical School (31). Consequently, the city council has no control over the hospital. The Board of Trustees of the University is obstensibly in control of policies, but the Board itself is composed of appointees who are in no way dependent upon the citizens for support. The Board then leaves control of the hospital to the university. Any attempts to gain control by the citizens are met with opposition from business and medical groups, politicians on the Board, and in council. Even if the politicians wanted to allow citizens to participate, the medical, financial, university, media, and industrial interests could successfully thwart any attempt by elected officials by threatening to withhold—as they have—either financial resources or medical services.

In 1972, for example, a citizens group—The People's Health Movement—collected over 15,000 signatures from concerned citizens to place a referendum on the ballot that would establish a commission from the county and city to operate the hospital. Enough signatures were eventually thrown out by the election board to deny the citizens a referendum or control of the hospital, but the city council had gotten the citizens to submit the petitions to the election board with a promise that more signatures could be added later. When more signatures were needed, the citizens group collected them, but the new city solicitor refused to allow them to be added with the others. The city council (with a vote of six members) could have put the referendum on the ballot, but since only five did so, a court decision was instituted, and the courts ruled the referendum invalid just before the November, 1973 election. Since there was a possibility that the citizens would get a vote on hospital control, however, the university president, administrators, politicians, medical and economic interests benefitting from control by a small group immediately massed their resources, issued statements to the media about what would happen if citizens controlled the hospital, and spent huge sums of money on advertisements in the local newspapers and other news media. A power-elite which benefits from isolating citizens from control of the hospital is unified and fully intends to maintain control of the hospital. By contrast, power elites in Cincinnati view transportation as an area not worth controlling, and citizens are even encouraged to participate in transportation decision-making, at least at low levels. This **low-level consultation of citizens is the pattern in many cities.**

The federal government mass transportation policies of the 1960's, which have placed more power in the hands of local and regional governmental officials and users, also encourage citizen participation but at low levels of decision-making thus far. These policies have also tended to fragment decision-making by emphasizing regionalism without providing enough support to make complete regional transportation possible. Since power-elites with unified goals and interests are not concerned with mass transit, politicians have been forced to promote regionalism in name, while protecting local interests at the same time. Since users are not powerful or interested enough as a group to promote a unified regional approach to transportation, decision-making degenerates into a process in which no one is in charge with each decision-making group remaining primarily interested in its own localities. There are exceptions to this rule, of course, and it is possible to construct a transportation system that does plan, implement, and carry out decisions with direct inputs from users.

The naive adoption of regionalism without attending to effects is sometimes justified on the grounds that this establishes a healthy pluralism in decision-making. Norman Wengert, while not uncritical of regionalism, took such a position (11, p. 380). The mere establishment of a regional commission with control over transportation is viewed as providing for pluralism, but the commission may be no more pluralistic than local governments or advisory bodies are normally and it could be even less so. Regionalism can result in the "no-one-



is-in-charge" arrangement; it can also result in true pluralism (Figure 4-1). But, the acceptance of regionalism as automatically establishing pluralism should be looked on with suspicion, and any true pluralist solution will have to include those who use and pay for mass transit.

Discussion of the advantages and disadvantages of regional administration over local government can be used to more concretely point up benefits and costs of regional approaches. Many have complained about the lack of speed in centralizing regional government control of transportation and environmental preservation. *California Tomorrow*, a plan for the future of that state developed by a nonprofit foundation of the same name, has strongly advocated that regional governments be formed and given many powers now exercised by local governments (5). The alternative to regionalization is said to be a system of "evergrowing numbers of separate, single-purpose bureaucracies with major regional responsibilities" (5, p. 25). Furthermore, the policy making bodies, as presently constructed, are apt to be immune to citizen control, subject to wealthy special interest groups, and unwilling to use voluntary regional cooperation effectively.

In *Democracy in the Space Age*, an elaboration of California's plan for regional government, the failure of local governments to be responsive to public needs was described. It contains criticism of the "multiple, conflicting regional authorities" who are also ineffective (5, pp. 15-19).

The argument that *regional government* is

a way of consolidating power for beneficial control of activity can be supplemented by citing other *advantageous characteristics*. **First,** there is the problem of spillover benefits and costs. The actions of one jurisdiction may help or hurt the residents of another, without considering the wishes of those who are not voting citizens of the decision-making unit. Effective sewage treatment will often benefit downstream communities more than one operating the facility. Traffic bottlenecks within one town will impede outsiders on through trips and may even create additional congestion in adjoining towns.

Second, there may be significant scale economies in joint efforts so that unit costs per citizen are lower when the size of a public venture gets larger. The cost per ton of processing sewage may be lower if four local governments combine to build one plant, rather than operating four separate ones. Similarly, dispatching, maintenance, and coordination of transportation systems may cost less per trip for a region-wide transportation system than they would for each part of the system acting as an independent unit.

A **third** area of support for regionalization lies in the pressures of competition for residents, businesses, and commercial patronage. If one town institutes strong pollution control measures at high cost, it might very well lose business and even residents to neighboring communities. Banning cars from its central business district may drive shoppers to other towns, so each local unit builds parking areas instead. In cases such as these, one community finds difficulting taking otherwise desirable action.

Regional government can contain more of the spillover benefits or damages of actions under one decision-making unit. It can construct facilities and institute systems which can attain the lower costs of larger scale operation. Since it encompasses a wider area, regional administration can also overcome the problems of competition in provision of services. These arguments, along with those in *California Tomorrow*, makes a case for shifting power from local to regional authorities. However, there are costs as well as benefits from such systems. One should consider these *disadvantages*.

One disadvantage of regionalization is the loss of individual impact which comes with smaller decision-making jurisdictions (38). Participatory democracy is much more difficult to achieve when millions of people and hundreds of square miles are covered by one governmental unit. On the other hand, one would certainly not argue that the small size of local governments so often causes them to be unresponsive to their citizens' demands. Special interests might manipulate local officials, but the Watergate, impeachment hearings, and Presidential resignation indicate that larger, more centralized power is not immune to this problem. People feel more control over their own lives when they have access to decision makers, and this access must decrease when power is more concentrated at higher levels of administration.

A **second** argument against regionalization attacks the proposed advantages of lower costs. Efficient scale economomies for different services may be achieved at very different levels of aggregation. Determining the optimal size for decision-making units is an extremely difficult job considering the multitude of activities under its jurisdiction. Moreover, there may be diseconomies of scale. Larger units can suffer from higher unit costs for services because of bureaucratic red tape and loss of control which occurs in bigger administrations. While the net effect of regionalization indeed may be lower costs, this conclusion should not be accepted uncritically.

A **final** area of objection to regionalization may be more esoteric, but it still should be considered. The elimination of competition may have deleterious effects on society's allocation of its scarce resources, and might not bring qualified benefits proclaimed by advocates of regionalism. Charles M. Tiebout has developed a theoretical model of local expenditures which show how efficiency is achieved in allocating resources to local public services in a manner analogous to the working of the market mechanism for private goods (34). Everyone has different values and tastes; therefore, one can reasonably expect each person would like to see his tax money used in a different way. Some would like to have elaborate, modern demand-responsive transportation systems at the expense of public golf courses. Others would prefer more and better public education. Some might even want to give up a number of services to get lower taxes. How can resources be used to satisfy each of these different attitudes?

The market mechanism allocates resources by means of prices. People indicate how much of a good they desire by paying the market price. The level of the market price signals producers how much they should supply. If people willingly pay for goods, they are likely to

be forthcoming; a lack of effective demand will mean a reduction or elimination of a good.

Since governments exist, at least in part, because some goods and services cannot be produced efficiently by the private market, there is no apparent way of providing signals, except for periodic majority votes. Indeed, if there were only one governmental unit, all one could do is try to influence decisions politically. However, if there were a large number of diversified communities, each citizen could also "vote with his feet" to get the proper mix of public services. He could chose to live in that town where the pattern of taxes and expenditures was closest to his wishes. If all communities were uniform because of centralized constraints on their actions, then the range of choice would be severely limited, and many people would be compelled to accept levels of services very different from those they desire. This implies that society as a whole can benefit from diversity of choices because more individuals can be happy about how their governments use their resources.

Having considered the possible damage to participatory democracy, the difficulties in the scale economies argument, and the loss of welfare resulting from a narrowing of choices, *one must conclude that there is not an unambiguous case for regionalization.* These arguments might also explain some of the resistance to this concept. One should not conclude that the case for regional governments is refuted; however, it should be clear that there are *costs*, as well as *benefits. Society must examine both before it decides* how much consolidation of jurisdictions should occur. In this area, as in so many public policy issues, the proper plea is that choices be made **intelligently**, and that ideal as well as feasible alternatives be presented for public consideration.

We cannot leave this discussion without focusing on a primary topic that arises whenever movement toward regionalism or metropolitanism is discussed: the role of blacks and other non-white minority groups in cities. One obstacle to metropolitan governments is the fear by blacks in cities that whatever power they have acquired will be diluted by regional or metropolitan governmental units. We have adequate historical data to realize that centralization of power or services, under the guise of reformism, has been used to take power away from groups that have it or are about to acquire power. The only way to assuage fears of minorities is to demonstrate by practice that regional and metropolitan coordination is not going to take away power or services but improve services for everyone. When blacks are included on regional commissions, advisory bodies, intergovernmental councils that include core cities and suburbs, then, and only then will it begin to be demonstrated that the core city does not have to fear a power loss. Blaming blacks for lack of coordination is avoiding the problem and is a failure to realize that there are adequate reasons for suspicion of regionalism.

A consideration of the economic, geographic, and demographic characteristics of the Tidewater, Virginia area (defined for purposes of this report as including both the Peninsula and Southeastern Planning District Commission regions) will point up some of the possibilities and difficulties to regionalism in Tidewater. In a later section, there will be a focus on transportation in Tidewater with special consideration given to regionalism.

II. Tidewater Today

A body of water known as Hampton Roads is flanked on the northwest by the Virginia Peninsula and on the south and southeast by the Southeastern Region of Virginia. Together, the two areas are known as Tidewater (See Figure 4-2), yet, they are not integrated economically, socially, or politically. Until now the two regions in Tidewater have developed separately and in sometimes opposite directions. This fact of **separateness rather than togetherness** should be borne in mind and should serve as a reminder that the designation "Tidewater" refers mainly to two areas that are in close (but not contiguous) geographic proximity and little else.

For the purpose of the following analysis the two regions have been identified in the following manners: The Peninsula is comprised of the five political units of Hampton, Newport News, Williamsburg, York County, and James City County. The five political units of the Southeastern Region are Norfolk, Virginia Beach, Portsmouth, Chesapeake, and Suffolk (46). It should be kept in mind in later discussions that the Southeastern Planning District also includes the Isle of Wight and Southampton County as well as these five political units.

There is no question that Hampton Roads and the James River have served historically as a natural barrier between the two areas. Currently these natural barriers are crossed by a two-lane toll bridge-tunnel between Hampton and Norfolk and by the James River Bridge bet-

ween Newport News and Isle of Wight (see Figure 4-3 of Bridge Crossings). Prior to construction of these connections, the two areas were linked only be ferry transportation. The areas are only seven miles apart at the closest point, but as one local businessman has observed, "the seven miles has seemed more like 700 miles."

In this section, some basic demographic, economic, and transportation characteristic of the area will be presented in order to provide a background for the subsequent analysis of political decision-making. The discussion included population growth, trends in urbanization, density patterns, commuting patterns, distribution of automobile ownership, and a brief economic analysis. The final topic in this section will discuss inter-jurisdictional problems in the area.

Population Growth and Projections

The Tidewater region of Virginia has grown substantially in the past decade and projections to the year 2000 indicate substantially more growth. Its present population (1970) is slightly over 1,000,000, with about 70 percent residing in the Southeastern Region (See Table IV-I). On the whole, the Peninsula recorded the greater increase in the past decade, growing by over 31 percent—almost twice as fast as the Southeastern Region. These gross summaries disguise some important differences within each region. In the Peninsula, all areas gained in population, even the city areas of Hampton and Newport News. The greatest increases, however, were in the upper Peninsula. In the Southeastern Region almost all the growth was concentrated in the resort city of Virginia Beach, which grew by 102 percent. In contrast, the population of the central city of Norfolk remained almost the same, while the population of Portsmouth declined by 9.2 percent.

Projections for the year 2000 foresee a population increase of over 50 percent for the region. Although such growth is not inevitable,

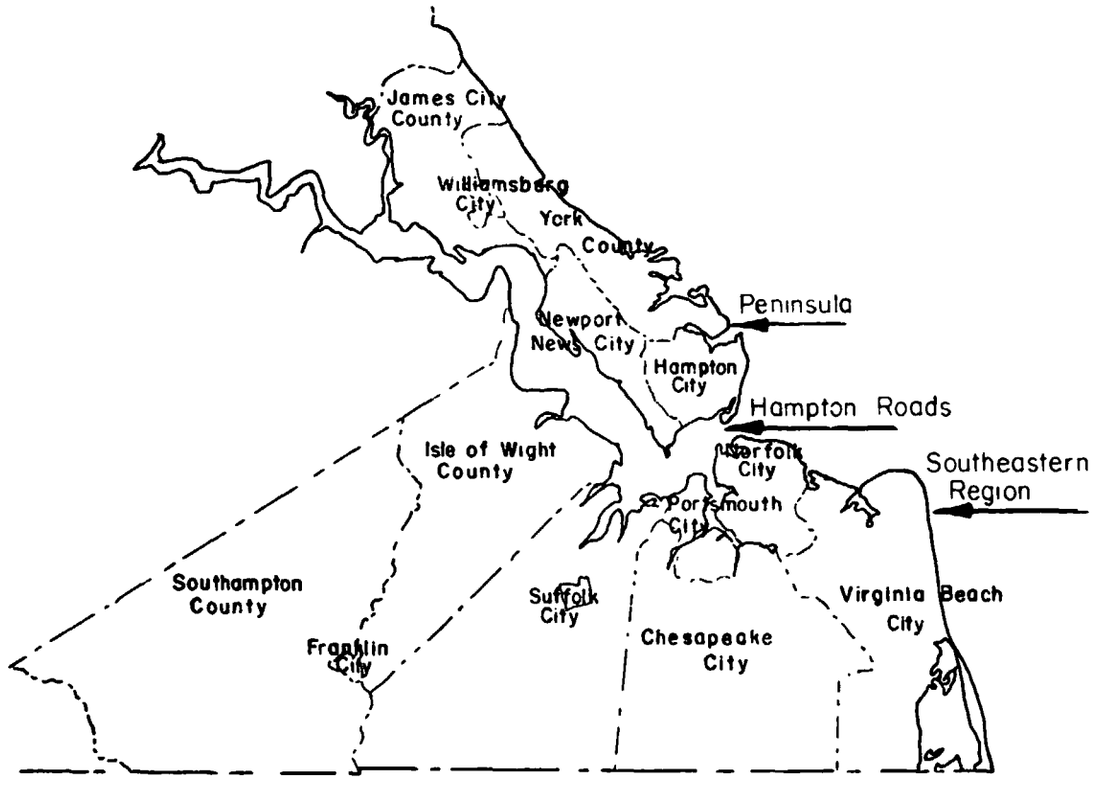


FIGURE 4-2
TIDEWATER, VIRGINIA

and despite the fact that actual growth undoubtedly either will exceed or fall short of the estimate, the projections have to be considered by planners, decision-makers, and others who are concerned with the future of this region.

The projections indicate continued faster growth for the Peninsula with an expected absolute increase of about 250,000 people. The Southeastern Region is expected to grow at a slower rate but still add 327,000 people. If these projections are realized, Newport News and Hampton will continue to dominate on the Peninsula side of Hampton Roads. On the Southeastern side, Virginia Beach will have succeeded demographically stagnant Norfolk as the largest city in Tidewater.

By the year 2000, Tidewater may also have expanded beyond the five political entities previously identified on each side of the harbor. Likely regions for inclusion in a future Tidewater include the Isle of Wight in the southeast (see Figure 4-2).

Urbanization in Tidewater

In the last decade, the percentage of the United States population residing in urban areas increased from 69.9 percent to 73.5 percent (47). Virginia, despite a more rapid increase in urbanization than in the nation during the last decade (13.1 percent compared to 5.2 percent) was still, in 1970, about 10 percent less than the nation as a whole (see Table IV-II).

Two of the three most highly urbanized regions in the state comprise the Tidewater area of Virginia. The Southeastern Region is the most highly urbanized with 89.4 percent urban in 1970. The 1970 percentage is an increase from 81.4 percent in 1960. This change is due primarily to change in two cities, Chesapeake and Virginia Beach. Chesapeake increased from 62.4 percent urban to 92.2 urban in 1970. Virginia Beach's urban population increased from 59.6 percent to 96.9 percent.

The Peninsula Region ranks third in urban population in the state (second is the Virginia

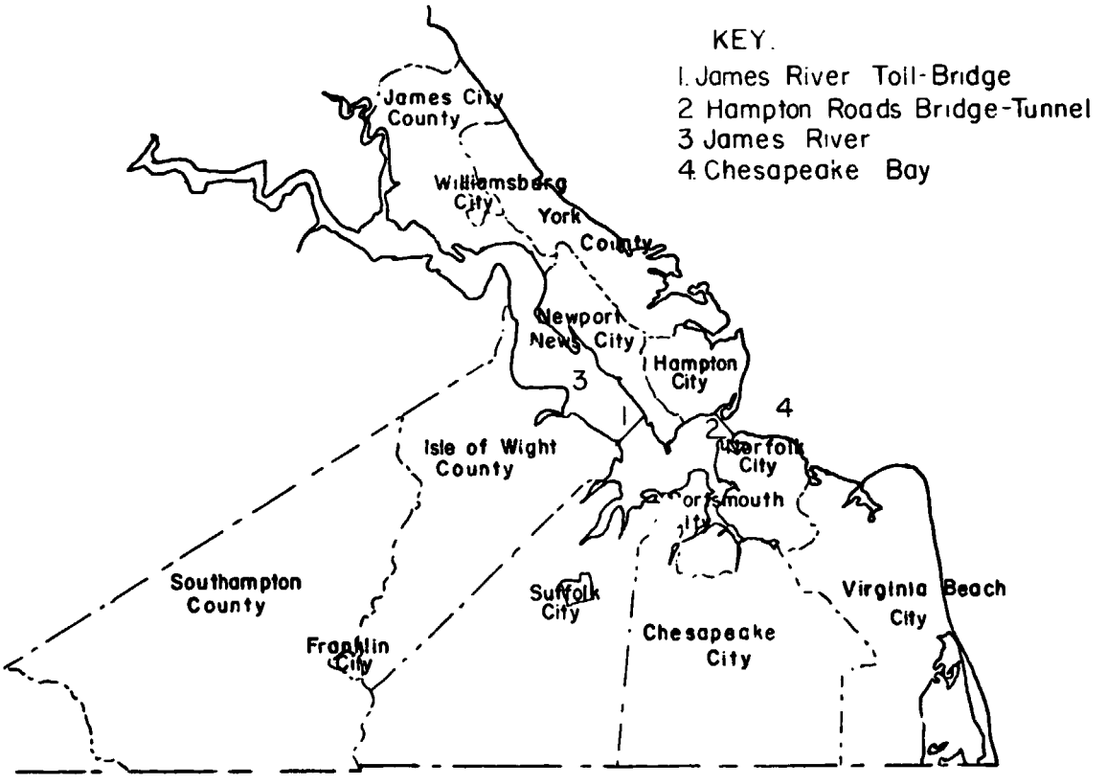


FIGURE 4-3
TIDEWATER, VIRGINIA

TABLE IV-I

Current and Projected Population Growth

	Population		Percent Change	Projected Population	Percent Change
Peninsula	**1960**	**1970**	**1960-1970**	**2000**	**1970-2000**
Hampton	89,258	120,779	35.3	197,200	63.3
Newport News	113,662	138,177	21.6	212,000	53.4
Williamsburg	8,362	9,069	8.5	12,000	32.3
James City County	10,449	17,853	70.9	51,000	185.7
York County	21,143	33,203	53.8	98,600	197.0
Total	242,874	319,081	31.4	570,800	78.9
Southeast					
Norfolk	304,869	307,951	1.0	305,000	-1.0
Virginia Beach	85,218	172,106	102.0	432,800	151.5
Portsmouth	122,173	110,963	-9.2	106,400	-4.1
Chesapeake	66,247	89,580	35.2	147,000	64.1
Suffolk	43,975	45,024	2.4	61,600	36.8
Total	622,482	725,624	16.6	1,052,800	45.1
Tidewater Total	865,356	1,044,705	20.7	1,623,600	55.4

Sources: —1960 Population, U.S. Bureau of Census, Chesapeake and Portsmouth 1960 totals adjusted for 1968 Churchland annexation from Chesapeake to Portsmouth.

—1970 Population, U.S. Bureau of Census

—Southeastern Virginia Planning District Commission, Memorandum RDR No. 42, Dec. 15, 1972, p. 5.

—Projections: Division of State Planning and Community Affairs, Commonwealth of Virginia, Statistical Information Series No. 72-2, September, 1972, p. 5.

suburbs of Washington, D.C.). Its urban population decreased slightly from 1960 to 1970. Taken together the Southeastern and Peninsula Regions of Virginia represent the largest and most urbanized region of the state (see Table IV-II).

Population Density

Instead of an area of dense, high-rise, urban communities, Tidewater is an area of urban sprawl. With the exception of Norfolk which has a fairly high density of almost 6,000 people per square mile, the other political units are relatively low in density (see Table IV-III).

"In that direction," the Cat said, waving its right paw round, "lives a Hatter: and in that direction," waving the other paw, "lives a March Hare. Visit either you like: they're both mad."

—Lewis Carroll

TABLE IV-II

Tidewater Urban-Rural Mix, 1960-1970

	Tidewater Regions	
Population	**Peninsula**	**Southeastern***
1960 Total	244,874	666,841
Urban	217,706	543,129
Rural	27,168	123,712
%Urban	88.8%	81.4%
1970 Total	319,081	769,371
Urban	277,332	687,710
Rural	41,749	81,661
%Urban		

* Includes also Isle of Wight and Southampton in addition to the SMSA.

Source: William J. Serow and Michael A. Spar. "Virginia's Population: of Change in Demographic Profile," Bureau of Population and Economic Research, University of Virginia, June 1972, p. 27.

TABLE IV-III

Population Densities in 1970

REGION	1970 POPULATION	LAND AREA (Sq. Miles)	GROSS DENSITY
Peninsula	**319,081**	**409.9**	**778.4**
Hampton	120,779	54.7	2,208.0
Newport News	138,177	69.1	1,999.7
Williamsburg	9,069	5.2	1,744.0
James City County	17,853	151.9	117.5
York County	33,203	129.0	257.4
Southeast	**725,624**	**1,087.2**	**667.4**
Norfolk	307,951	52.3	5,888.2
Virginia Beach	172,106	258.7	665.3
Portsmouth	110,963	29.9	3,711.2
Chesapeake	89,580	336.8	266.0
Suffolk	45,024	409.5	109.9

Sources: Projections and Economic Base Analysis: The Virginia Peninsula p. 21. Projections and Economic Base Analysis: Norfolk-Virginia Beach-Portsmouth Metropolitan Area, p. 15.

On the Peninsula side, Hampton and Newport News each have about 2,000 persons per square mile, but density is much lower in the more rural areas of James City County and York County. On the Southeastern side, the cities of Virginia Beach, Chesapeake, and Suffolk all have extremely low densities. This is accounted for by the tremendous land area

TABLE IV-IV

Commuting Pattern Data for the Virginia Peninsula

Places of Work for Residents of the Virginia Peninsula

Residence / Employment	Newport News	Hampton	York County	James City County	Williamsburg	In-Commuters				Total Employment
						N-P Met Area*	Other SE**	Gloucester-Matthews-Middlesex-	Other	
Newport News	41,140 75 5%	14,355 31 9%	3,231 26.0%	810 13.1%	238 7 0%	2,592	1,026	1,072	378	64,842
Hampton	7,906 14 5%	26,127 58 1%	2,703 21.8%	122 2.0%	41 1.2%	1,528	92	265	23	38,807
York County	949 1 7%	397 0 9%	3,935 31 7%	494 8.0%	173 5.1%	137	14	793	157	7,049
James City County	336 0 6%	55 0 1%	373 3 0%	1,520 24 6%	141 4.1%	8	60	121	102	2,716
Williamsburg	518 1 0%	158 0.4%	1,515 12 2%	2,999 48.5%	2,761 80.6%	23	57	401	469	8,901
Norfolk-Portsmouth Metropolitan Area*	2,515 4 6%	3,260 7 2%	393 3.2%	20 0.3%	-	4,288 6,188	1,249	2,652	1,129	122,315
Other S E Region **	276 0 5%	185 0 4%	48 0 4%	-	-	509				
Elsewhere	851 1 6%	468 1 0%	225 1 8%	213 3.4%	65 1 9%	1,822				
Total Reporting Place of employment	54,491	45,005	12,423	6,178	3,419	121,516				
Place of employment not reported	4,062	2,542	850	211	350	8,015				

In-commuters = 9,318
Out-commuters = 8,519
Net In-commuters = 799

* Cities of Norfolk, Portsmouth, Va Beach, Chesapeake, and Suffolk.

** Counties of Isle of Wight, Surry, Southampton and City of Franklin

Note: Percentages based on Total reporting place of employment

Source: Division of State Planning and Community Affairs, **The Virginia Peninsula**, 73-3, May 1973. (Based upon unpublished tabulations of 15 percent sample, U.S. Bureau of the Census, **Census of Population: 1970**).

TABLE IV-V

Commuting Pattern Data for the Southeastern Virginia Planning District

Places of Work for Residents of the Southeast Virginia Region

Residence / Employment	Norfolk	Virginia Beach	Ports-mouth	Chesapeake	Suffolk	Franklin Isle of Wight S. Hampton	In-Commuters			Total Employ-ment
							Peninsula Region	North Carolina	Other	
Norfolk	111,153 89 2%	23,799 37 5%	8,313 21.7%	12,038 40 0%	997 65.0%	219 1.6%	2525	1312	187	160,543
Virginia Beach	4,966 4 0%	34,302 54 1%	677 1 7%	1,756 5 8%	94 0 6%	13 0 1%	1652	257	26	43,773
Portsmouth	3,160 2 5%	1,737 2 7%	25,552 66 8%	5,926 19 7%	1,658 10 8%	329 2.3%	948	542	-	39,852
Chesapeake	1 975 1 6%	1,512 2 4%	1,576 4 1%	8,973 29 8%	163 1 1%	28 0.2%	1003	277	-	15,507
Suffolk	172 0 1%	64 0 1%	469 1 2%	270 0 9%	10,757 70 2%	516 3.7%	60	222	14	12,544
Franklin-Isle of Wight-S Hampton	49 -	12 -	118 0 3%	99 0 3%	797 5 2%	11,203 79.8%	181	394	374	13,227
Peninsula	1,624 1 3%	822 1 3%	834 2 2%	403 1.3%	605 3 9%	927 6.6%	6369 5215	3004	601	285,446
Other	1,547 1 2%	1,183 1 9%	717 1.9%	599 2 0%	255 1.7%	806 5.7%	5107			
Total	124,676	63,431	38,256	30,064	15,326	14,041	185,794			
Work not reported	13,416	6,682	2,897	1,761	1,200	905	26,861			

In-commuters = 9974
Out-commuters = 10322
Net Out-commuters = 348

Source: Division of State Planning and Community Affairs (Based upon unpublished tabulations of 15 percent sample, U. S. Bureau of the Census, *Census of Population: 1970.*)

each occupies—they are the three largest cities in the United States in terms of land area—and by the fact that a large percentage of those areas is devoted to agricultural pursuits.

In Virginia Beach, for example, 38 percent of the land area is farm, and agriculture in this "city" brought in 70 million dollars to the economy, compared to 200 million dollars for tourism. Chesapeake has a large percentage of its land occupied by the Dismal Swamp—an area extremely unlikely to be invaded by automobiles and shopping centers.

The figures on density show there is still considerable room for expansion to accommodate the expected increases in population growth. Instead of being in a position where growth will have to stop or be redirected upward, growth in Tidewater can and probably will continue outward unless conscious planning and decision-making efforts prevent it.

Commuting Patterns

An analysis of the 1970 commuting patterns for the Peninsula Region (Table IV-IV) shows that 75,483 out of the 121,516 people reporting a place of employment, 62.1 percent work in the same city or county in which they reside. For the Southeastern Region (Table IV-V), 201,940 out of 285,794 or 70.7 percent work in the same city or county in which they reside. There are about 6,000 workers crossing the James River and Hampton Roads daily in each direction. 5,537 are going to work in the Peninsula Region and 6,699 in the Southeastern Region. (Note: the river crossing figures include the County of Surry.)

The Peninsula Region also has 3,781 other in-commuters primarily coming from Gloucester, Mathews, and Middlesex counties across the York River. Most of these in-commuters work at the Newport News Shipbuilding and Dry Dock Company (about 26,000 employees). Of the remainder, substantial numbers are military related. There are also 1,822 out-commuters besides those working in the Southeastern Region. Most of these do not work in nearby cities or counties and are probably military personnel. The Southeastern region has a total of 10,322 out-commuters and 9,974 in-commuters. Most of the out-commuters not working in the Peninsula Region do not work in nearby areas and again are probably military personnel. There are 3,605 in-commuters to the Southeastern Region from other than the Peninsula Region. Of these, 3,044 come from North Carolina with the remainder from nearby Virginia areas.

All the cities and counties in the region except perhaps Portsmouth are either very "job rich," i.e., more jobs available than residents reporting a place of work, or "job poor." Table IV-VI indicates that about 53,000 commuters are generated by the imbalance of jobs and workers among the various political subdivisions in the area. This corresponds to about one-eighth of the jobs, a fraction about the same in both the Peninsula and Southeastern Regions. Since the city of Williamsburg is relatively small and completely surrounded by James City County, it might be appropriate to combine their figures. The two combined are "job rich" by 2,020 jobs which is 21.0 percent of the residents reporting a place of work and 17.4 percent of the jobs in the combined area.

Even with this adjustment, there is still an imbalance of almost 50,000 employees or jobs. It is difficult to assess the significance of this figure in the Tidewater area. Almost all of the imbalance is due to the job rich cities of Norfolk and Newport News. Each of these cities accounts for over 50 percent of the employment in its respective region. Further, each city is dominated by a single employer. About 40 percent of the jobs in Newport News are at the Newport News Shipbuilding and Dry Dock Company. Similarly, about 40 percent of the jobs in Norfolk are at Naval installations in the city.

As will be pointed out in greater detail later in this chapter, a considerable amount of cooperation between the cities on the Virginia Peninsula and the cities of the Southeastern Region will be required if a sound mass transportation system is to be developed for Tidewater, Virginia. Currently Newport News is in the Peninsula Transportation District and Norfolk is in the Tidewater Transportation District (which includes Norfolk, Virginia Beach, Portsmouth, and Chesapeake).

Economic Activity

When a member of the business community of the Southeastern Region was asked "What is the industrial base for the region?" he reported, "There is no industrial base!" His response came close to the mark, for the largest three manufacturing employers in the region are General Electric Company, Ford Motor Company, and Norfolk Shipbuilding and Dry Dock Company, with a combined employment of only 8,600 (10, p. 38). Total manufacturing employment in the region was only 29,100 of the total employment of 347,000 or 8.4 percent (see Table IV-VII).

An inspection of Table IV-VII reveals that manufacturing employment in the **Peninsula** is the largest sector of employment with 22.2 per-

TABLE IV-VI
Job Rich and Job Poor Areas in Tidewater

	Number	Number as Percent of Residents Reporting Place of Work	Number as Percent of Employment
Norfolk	35,867	28.8%	22.3%
Newport News	10,351	19.0%	16.0%
Williamsburg	5,482	160.3%	61.6%
Portsmouth	1,590	4.2%	4.0%
Job Poor Cities and Counties			
Franklin, Isle of Wight, Southampton	814	5.8%	6.2%
Suffolk	2,782	18.2%	22.2%
James City County	3,462	56.0%	127.5%
York County	5,444	43.8%	77.2%
Hampton	6,198	13.8%	16.0%
Chesapeake	14,557	48.4%	93.9%
Virginia Beach	19,658	31.0%	44.9%

Source: Derived from Table IV-IV and Table IV-V.

cent compared with the 8.4 percent in the Southeastern Region. This 22.2 percent figure would imply a high degree of industrialization for the Peninsula. However, this figure is somewhat misleading on at least two counts. First, 26,000 of the 35,500 employees in manufacturing in the Peninsula are employed at the Newport News Shipbuilding and Dry Dock Company, i.e., 73 percent of the manufacturing employment in the Peninsula is with one firm located in Newport News. Therefore, with the exception of Newport News, the Peninsula has a low degree of industrialization (48). Second, since almost all of the Shipyard's work is contracted with the United States Department of Defense, there is serious question if the 26,000 employees should be classified with civilian manufacturing employment. Perhaps they should be added to the government employment figure of 34,900.

Military employment in both areas of Tidewater is very important. It is the chief employer in the Southeastern Region accounting for almost one-fourth of total employment (23.0 percent) and is the third largest source of total employment on the Peninsula with 13.1 percent. The second largest empioyment sector in both areas is with civilian government. In the Peninsula, government employment is 21.8 percent of total employment and the corresponding percentage in the Southeastern Region is 18.9 percent. If military and government employment are added for both areas then employment directly related to government would be 41.9 percent in the Southeastern Region and 34.9 percent in the Peninsula. There is no doubt that the economies on both sides of Hampton Roads are directly related to the public sector.

Area Cooperation

Until recently, the Virginia Peninsula and the Southeastern Region economically have developed in oppositedirections from Hampton Roads. To be sure, the natural barrier of Hampton Roads will be reduced in late 1975 when the second bridge-tunnel is completed and the four-lane Interstate 64 is scheduled to become a toll-free crossing. A proposed toll-free, four-lane crossing between Newport News and Portsmouth (scheduled for completion in about ten years) will decrease further this real barrier to economic activity. The Peninsula currently is connected to the west by an old toll bridge across the James River. When the

TABLE IV-VI

TIDEWATER EMPLOYMENT IN 1973

Type of Employment	Southeastern Region Employment (000)	Southeastern Region Percent of Total Employment	Virginia Peninsula Employment (000)	Virginia Peninsula Percent of Total Employment
I. Nonagricultural Civilian	264.9	76.2	138.1	86.4
Manufacturing	29.1	8.4	35.5	22.2
Durable Goods	17.4	5.0	30.2	18.9
Nondurable Goods	11.7	3.4	5.3	3.3
Nonmanufacturing	235.8	67.8	102.6	64.2
Contract Construction	19.2	5.5	7.2	4.5
Transportation and Public Utilities	17.3	5.0	4.4	2.8
Wholesale Trade	11.9	3.4	2.7	1.7
Retail Trade	47.2	13.6	19.4	12.1
Finance, Insurance, Real Estate	11.8	3.4	3.9	2.4
Service, Miscellaneous, Mining	39.0	11.2	19.9	12.4
Government	65.7	18.9	34.9	21.8
Federal Government	33.6	9.7	17.5	10.9
State and Local Government	32.1	9.2	17.4	10.9
Self Employed, Domestics, Unpaid Family Workers*	23.7	6.8	10.2	6.4
II. Agricultural*	2.8	0.8	0.8	0.5
III. Military	80.0	23.0	20.9	13.1
Total Employment	347.7	100.0	159.8	100.0

* Place of residence. Other items by place of work.

Source: Virginia Employment Commission, Southeastern Virginia Planning District Commission, and Peninsula Planning District Commission.

modern toll-free bridge now under construction is open for traffic, Tidewater geographical isolation will be reduced further.

Another repelling force has been the very fierce competition between the cities on each side of Hampton Roads. Traditionally, for example, the commercial city of Norfolk and the bedroom city of Virginia Beach have been at great odds. An example of the results of such intercity competition is the Norfolk Airport and an industrial park in Virginia Beach. The Norfolk Airport borders the Virginia Beach Industrial Park. However, Norfolk has been unwilling to provide road access to their so-called Norfolk Regional Airport and the Virginia Beach Industrial Park. An official from one of the two cities has noted that it is almost like having another Hampton Roads between the two facilities.

On the Peninsula side there is the rivalry between Hampton and Newport News. A short time ago it was decided that the Newport News-

Hampton area could benefit from the construction of a Convention Center. When Newport News discovered that an optimal location would put the Center in Hampton, the City of Newport News apparently withdrew its support. The rivalry between Tidewater cities also bridges Hampton Roads since Norfolk and Hampton have Convention Centers. Virginia Beach is now planning its center.

In order to have an official reviewing agency for federal funding, the five political units of the Peninsula area have formed the Peninsula Planning District Commission and the five political units in the Southeastern Region have joined the Southeastern Virginia Planning District Commission. Also, in order to obtain Urban Mass Transit Administration (UMTA) funding, the cities of Norfolk, Virginia Beach, Portsmouth, and Chesapeake have joined the Tidewater Transportation District Commission, and Newport News and Hampton are in the process of forming the Peninsula Transit District Commission. Therefore, at least seven of the ten Tidewater political units are cooperating to some degree.

Politically imposed state and federal cooperation is relatively recent. However, cooperation between the political units on both sides of Hampton Roads back to at least 1958 when the Hampton Roads Area Committee was organized by an ex-governor of Virginia (49). This committee consists of the mayors, the city managers, and one interested citizen from each political unit in Tidewater. The Hampton Roads Area Committee meets periodically to discuss areas of mutual concern so they can jointly approach the Commonwealth of Virginia for assistance in the solution of mutual problems, i.e., this committee has been and is an active lobbying group. Not only are the leaders of the political unit in Tidewater discussing mutual problems, but they are also a positive action group.

Another very strong repelling force is an isolationist frame of mind. Given the natural barrier of Hampton Roads and the sharp city rivalries, many citizens on both sides have their backs to Hampton Roads and can only see as far as their own city limits. This type of isolationism became apparent to the interviewers after only a few of the many interviews conducted for this study. There are few residents who view themselves as Tidewater citizens. Most **natives** identify with only their immediate area.

Businessmen can also suffer from city isolationism. For example, if there is a Virginia Beach Chamber of Commerce which reports only business news in Virginia Beach to its Virginia Beach member, then the perceived economic area for Virginia Beach firms will tend to be Virginia Beach. Currently, there is a separate Chamber of Commerce for Norfolk, Virginia Beach, Portsmouth, **and** Chesapeake. In contrast, there is an active (1,100 members) Peninsula Chamber of Commerce with four of the five political units included—only Williamsburg has a separate Chamber of Commerce. However, the Chambers of Commerce of Norfolk, Virginia Beach, Portsmouth, and Chesapeake recently have organized a committee on area cooperation. This eight-person committee is composed of the past two presidents of each of the four separate organizations. Therefore, this committee is a top-level area business community group. This committee has stated that "the future of Hampton Roads is directly affected by the development of all communities. Lack of cooperation among **any** of these communities is detrimental to all" (29, p. 2).

The territoraility of economic development activities in Tidewater can be another disunifying force. There is a Norfolk Economic Development Council which is actively courting new business firms **for Norfolk.** This council is in competition with similar promotional agencies in Virginia Beach **and** Portsmouth **and** Chesapeake. Suffolk is currently in the process of hiring such a professional staff. Until a few years ago, there was a well financed Tidewater Virginia Development Council supported by the political units in the Southeastern Region, e.g., the city of Norfolk provided $48,000 and the city of Virginia Beach provided $20,000 support. Norfolk's current contribution in only $5,000 and Virginia Beach's contribution is only $3,500. Jointly, these two city contributions provide less than ten percent of the Tidewater Virginia Development Council's Budget (50).

In contrast, three years ago the Virginia Peninsula Industrial Committee (VPIC) had no financial support from the political units. Last year both Hampton and Newport News contributed $5,000 to VPIC and the current level of funding is $10,000 each, with another $2,500 from York County and $1,000 from James City County. The four contributing units now account for almost one-fourth of VPIC's budget (51).

Until recently, Tidewater had three ports under the separate direction of Peninsula Port Authority, Norfolk Port and Industrial Authority,

and the Portsmouth Port Authority. The Virginia Port Authority has taken control of the three ports. Therefore, the three ports cooperate with one another instead of competing.

Another very important disunifying force is the newspaper "black-out" in Tidewater. There is a monopoly press on the Peninsula side (in Newport News) and another monopoly press in the Southeastern Region (in Norfolk). These two communication firms generally refuse to (1) accept advertising for businesses located on the other side of Hampton Roads; (2) report news in the other areas; and, (3) circulate their papers across the Hampton Roads. How has such a newspaper "black-out" in Tidewater continued into the latter half of the 20th century? In part it can be explained in terms of the natural barrier of Hampton Roads and the frame of mind earlier referred to as city isolationism. The explanation on at least one side of Hampton Roads is that the newspaper interest, the financial interest, **and** the real estate interest are basically the **same** interest group.

Generally, the newspaper communication "black-out" is still a disunifying factor in Tidewater. However, certain national chain-stores such as Sears, Roebuck and Company are able to list all Tidewater outlets in their newspaper advertising. Also, the television and radio stations in Tidewater have no prohibition on advertising for firms located outside the station's geographic location. In fact, there are television stations like WTAR and WAVY which give station identifications with the words "Norfolk-Portsmouth-Newport News" and "Hampton-Norfolk-Newport News" respectively.

The larger real estate firms have property listings and branch offices in more than one Tidewater city. One of the largest realty firms in Tidewater advertises on television that they can provide service in any one of the Tidewater cities. The Newport News-Hampton Board of Realtors, Inc. includes realtors from York County, and some realtors in the Newport News-Hampton Board are on the Williamsburg Board of Realtors. On the Southeastern Region side there is a realty board for Norfolk-Chesapeake, Portsmouth-Chesapeake, and Virginia Beach. There is a cross membership in these three boards and on the two boards on the Peninsula. In fact, all the realtor boards in Tidewater make up Region 6 of the Virginia Realtors Association. Given the area-wide perspective of some Tidewater realtors, it was not surprising to find a Norfolk-based realty firm developing the new Military Circle Mall in the Southeastern Region and the Coliseum Mall in Hampton. The Tidewater wide realtor-interest is complemented by some financial interest.

Bankers, like realtors, who have no branch offices—who have only city-wide branches or branches restricted to a given county—tend to have a relatively limited geographic focus. The same is true of other financial institutions such as savings and loans associations. In 1962 the Commonwealth of Virginia removed area restrictions on branch banking to the extent of permitting state-wide branching. Since 1962 the structure of banking in Virginia and in Tidewater has changed, e.g., between 1962 and 1968 more than half of Virginia's unit banks (a unit bank is a bank with only one office) were absorbed into branch systems (3).

At the end of 1968, there were no Norfolk-based unit banks, for all four of the remaining Norfolk banks had branch offices in Virginia Beach (see Table IV-VIIIa). The largest bank, Virginia National, had a total of six branches in Virginia Beach, Chesapeake, and Suffolk, with another eight offices in Hampton. Totally, the four Norfolk banks had 24 branches outside of their head-office city by the end of 1968. In contrast, Virginia National Bank alone had 22 branches outside of Norfolk, and the five Norfolk branch banks had 46 branches outside of Norfolk by the end of 1973 (see Table IV-IXa). In addition to the number of branches outside Norfolk increasing from 24 to 46 over the 1969-1973 period, the area served increased, e.g., Virginia National Bank had 14 branches in Virginia Beach, Chesapeake, Suffolk, and Hampton in 1969. By the end of 1973, Virginia National Bank had added ten more branches in these four cities and had established two branches in Portsmouth.

The two Portsmouth banks with branches outside Portsmouth had four such branches in Chesapeake and in Suffolk at the end of 1969 (see Table IV-VIIIc). By the end of 1973, the three Portsmouth Banks with branches outside Portsmouth had five such branches in Chesapeake and Suffolk, with one branch in Norfolk (see Table IV-IXc). The only Chesapeake-based bank had no branches outside of Chesapeake in 1969, while the only Chesapeake-based bank had 11 such branches by 1973 (see Table IV-VIIId and Table IV-IXd). These 11 branches were located in Norfolk, Virginia Beach, and Portsmouth (52).

To this point, we have observed that some banks located in Norfolk, Portsmouth, and Chesapeake have extended their geographical operations during the 1969-1973 period. The

TABLE IV-VIII

SOUTHEASTERN VIRGINIA BANKING STRUCTURE
JANUARY 1, 1969

Norfolk Banks

Name of Bank	Number of Branches: In Head-Office City	Number of Branches: Outside Head-Office City
First National Bank of Norfolk	1	2
In Virginia Beach	-	1
In Chesapeake	-	1
Seaboard Citizens National Bank	7	6
In Virginia Beach	-	4
In Chesapeake	-	1
In Suffolk	-	1
Southern Bank of Norfolk	14	2
In Virginia Beach	-	2
Virginia National Bank	13	14
In Virginia Beach	-	2
In Chesapeake	-	2
In Suffolk	-	2
In Hampton	-	8

b. Virginia Beach Banks

Name of Bank	Number of Branches: In Head-Office City	Number of Branches: Outside Head-Office City
The First Colonial Bank	1	-

c. Portsmouth Banks

Name of Bank	Number of Branches: In Head-Office City	Number of Branches: Outside Head-Office City
Merchants and Farmers Bank	3	-
American National Bank	4	3
In Chesapeake	-	1
In Suffolk	-	2
Citizens Trust Company	1	1
In Chesapeake	-	1

d. Chesapeake Banks

Name of Bank	Number of Branches: In Head-Office City	Number of Branches: Outside Head-Office City
People's Bank of Chesapeake	1	-

e. Suffolk Banks

Name of Bank	Number of Branches: In Head-Office City	Number of Branches: Outside Head-Office City
Bank of Suffolk	-	-

Source: *Operating Banking Offices*, January 1, 1969, Federal Deposit Insurance Corporation, pp. 501-514.

TABLE IV-IX

SOUTHEASTERN VIRGINIA BANKING STRUCTURE
DECEMBER 31, 1973

a. Norfolk Banks

Name of Bank	Number of Branches: In Head-Office City	Number of Branches: Outside Head-Office City
Atlantic National Bank	-	-
Bank of The Commonwealth	-	-
Bank of Virginia - Tidewater	4	6
In Virginia Beach	-	4
In Portsmouth	-	1
In Chesapeake	-	1
First National Bank of Norfolk	3	4
In Virginia Beach	-	3
In Chesapeake	-	1
First Virginia Bank of Tidewater	15	4
In Virginia Beach	-	4
United Virginia Bank/Seaboard National	9	10
In Virginia Beach	-	5
In Portsmouth	-	3
In Chesapeake	-	1
In Suffolk	-	1
Virginia National Bank	16	22
In Virginia Beach	-	7
In Portsmouth	-	2
In Chesapeake	-	2
In Suffolk	-	2
In Hampton	-	9

b. Virginia Beach Banks

Name of Bank	Number of Branches: In Head-Office City	Number of Branches: Outside Head-Office City
People's Bank of Virginia Beach	5	-

c. Portsmouth Banks

Name of Bank	Number of Branches: In Head-Office City	Number of Branches: Outside Head-Office City
American National Bank	6	3
In Chesapeake	-	1
In Suffolk	-	2
Citizens Trust Bank	4	1
In Norfolk	-	1
Merchants and Farmers Bank	3	2
In Chesapeake	-	2

d. Chesapeake Banks

Name of Bank	Number of Branches In Head-Office City	Number of Branches Outside Head-Office City
First & Merchants Bank National		
Bank of Tidewater	2	11
In Norfolk	-	2
In Virginia Beach	-	8
In Portsmouth	-	1

e. Suffolk Banks

Name of Bank	Number of Branches In Head-Office City	Number of Branches Outside Head-Office City
Bank of Suffolk	1	-
First Virginia Bank of Nansemond	1	-

Source: *Operating Banking Offices*, December 31, 1973, Federal Deposit Insurance Corporation, pp. 605-622.

few banks in Virginia Beach and Suffolk have not branched beyond their city limits (see Table IV-VIIIb, Table IV-VIIIc, Table IV-IXb, and Table IV-IXe).

An inspection of Table IV-X reveals that Newport News was the financial center on the Virginia Peninsula in 1969. The three Newport News branch banks had 15 branches, five of which were located in Hampton. Williamsburg had the only other branch bank with an outside branch on the Peninsula with that bank's only branch located in James City County.

By the end of 1973, neither Hampton nor Williamsburg had banks with offices located outside of the city (see Table IV-XIb and Table IV-XId). The bank of Hampton Roads in Newport News had established two branches in Hampton during the 1969-1973 period and two other Newport News banks had established for the first three branches in Hampton.

York County is where the greatest change took place between 1969 and 1973. The three York County banks were established during the 1969-1973 period. These three banks had five branches in Hampton and Newport News by the close of 1973 (see Table IV-XIc). Several banks in Tidewater appear to have extended their geographic scope of economic influence, i.e., Tidewater banks are making a break from the traditional city isolationism.

To be sure, the city isolationism discussed above is showing real signs of weakening. In part this weakening of city vested interest can be explained in terms of growth in population between 1960 and 1970. Tidewater has had a large influx of people during the 1960-1970 period. Such immigration erodes provincial views. Of the persons five years or older living in either the Virginia Peninsula or the Southeastern Region in 1970, 23 percent lived outside of these two areas, in 1965 (53) In addition to the considerable immigration into the two areas, there is extensive daily migration within the two areas, between the two areas, and outside of the two areas, e.g., only 11.7 percent of the 10,033 personnel at the Norfolk Naval Shipyard live in Norfolk with about 80 percent living in the other four cities in the region. Five percent of the Shipyard's personnel reside in North Carolina and another one percent commute daily to the Peninsula (17).

In a study of commuting patterns of personnel at the Newport News Shipbuilding and Dry Dock Company, it was found that 28.1 percent of the 26,837 employees lived in Hampton. Eleven percent resided off the Peninsula to the

TABLE IV-X

VIRGINIA PENINSULA BANKING STRUCTURE
JANUARY 1, 1969

a. Newport News

Name of Bank	Number of Branches	
	In Head-Office City	Outside Head-Office City
Bank of Hampton Roads	3	-
Bank of Newport News	-	-
Bank of Warwick	4	-
Citizens and Marine Bank	3	5
In Hampton	-	5

b. Hampton Banks

Name of Bank	Number of Branches	
	In Head-Office City	Outside Head-Office City
The Old Point National Bank of Phoebus	1	

c. Yorktown Banks

Name of Bank	Number of Branches	
	In Head-Office City	Outside Head-Office City
The First National Bank of Yorktown	-	-

d. Williamsburg Banks

Name of Bank	Number of Branches	
	In Head-Office City	Outside Head-Office City
Williamsburg National Bank	-	-
Peninsula and Trust Company	1	1
In James City County	-	1

Source. *Operating Banking Offices*, January 1, 1969, Federal Deposit Insurance Corporation, pp. 501-514.

west and another four percent commuted to the Southeastern Region (54).

If a firm such as the Newport News Shipbuilding and Dry Dock Company is locally owned with hometown management, then one would expect that local management would tend to be provincial. In 1968, Tenneco of Houston acquired the Newport News Shipyard (55). Over the last few years Tenneco has replaced local management with head-office-trained personnel. There is little doubt that the more cosmopolitan type management at the Newport News Shipyard will have a strong influence on both business and political leadership in Tidewater since this shipyard is the largest single private firm in the state of Virginia.

There is no question that the Virginia Peninsula and the Southeastern Regions have developed economically in opposite directions

TABLE IV-XI

VIRGINIA PENINSULA BANKING STRUCTURE
December 31, 1973

a. Newport News Banks

Name of Bank	Number of Branches: In Head-Office City	Number of Branches: Outside Head-Office City
Bank of Newport News	1	-
First City Bank of Newport News	2	-
Bank of Hampton Roads	4	2
In Hampton	-	2
Bank of Virginia-Peninsula	6	1
In Hampton	-	1
United Virginia Bank/Citizens & Marine	4	6
In Hampton	-	6

b. Hampton Banks

Name of Bank	Number of Branches: In Head-Office City	Number of Branches: Outside Head-Office City
First Peninsula Bank and Trust Company	-	-
The Old Point National Bank of Phoebus	3	-

c. York County Banks

Name of Bank	Number of Branches: In Head-Office City	Number of Branches: Outside Head-Office City
Dominion National Bank of the Peninsula	-	2
In Newport News	-	2
First & Merchants National Bank of the Peninsula	-	1
In Hampton	-	1
First Virginia Bank of the Peninsula	-	3
In Hampton	-	1
In Newport News	-	2
The First National Bank of Yorktown	-	1

d. Williamsburg Banks

Name of Bank	Number of Branches: In Head-Office City	Number of Branches: Outside Head-Office City
Tidewater Bank and Trust Company	-	-
Williamsburg National Bank	1	-
United Virginia Bank of Williamsburg	2	-

e. James City County Banks

Name of Bank	Number of Branches In Head-Office City	Number of Branches Outside Head-Office City
Old Colony Bank and Trust Company	-	-

Source: *Operating Banking Offices*, December 31, 1973, Federal Deposit Insurance Corporation, pp. 605-622.

from Hampton Roads and this trend is now reversed. What can be expected in the future?

As first the degree of both political and economic cooperation will increase, e.g., within a very short time, there will be only one Chamber of Commerce in the Southeastern Region, and shortly thereafter it will be merged at least functionally with the Peninsula Chamber of Commerce. Also some cooperation is now taking place between the Tidewater Virginia Development Council of the Southeastern Region and the Virginia Peninsula Industrial Committee. Tidewater is, or soon will be, one economic region.

The Hampton Roads Area Committee is comprised of all of the mayors, city managers, and one interested citizen from each political unit in Tidewater. This committee has met repeatedly for more than a decade with the expressed purpose of acting as the Tidewater lobby. "Metro" government is not a popular topic because of the current intercity rivalry; however, when it comes to non-local funds, the Hampton Roads Area Committee resembles a metropolitan form of government.

III. Decision-Making and Regionalism

The dominant features of the Tidewater area and the possibilities for economic integration must be kept firmly in mind in considering transportation in Tidewater. A major question to be addressed is whether transportation in Tidewater is going to be developed for the area as a whole, or whether each region is going to develop separate transportation facilities. Within each region, questions about cooperation within local jurisdictions must also be addressed. Since regional transportation commissions are so new in Tidewater, very little can be determined about how successful the commissions will be in bringing adequate transportation to each region, and whether the two transportation district commissions can bring the Tidewater regions together with a coordinated transportation program (24). In this section of the report, we will examine the implications of regional cooperation for the whole Tidewater area. **Localism** will refer here to a focus on local matters to the detriment of regionalism. **Regionalism** will refer to the coordination of local political jurisdictions to resolve specific problems, and **metropolitanism** will refer to the coordination of several interrelated characteristics of a region.

The development of urban regional transportation coordination has been given direction from the federal government by the 1964 Urban Transportation Act. The act encouraged communities to resolve problems through coordination. Some states went even further by passing legislation requiring all solution of mass transportation problems to be made on a regional basis. In Virginia, the Transportation District Commission Act of 1964 established the powers of such district commissions (37). With the exception of Northern Virginia whose transit district was created by separate legislation, no regional Transportation District Commissions were established in Virginia until 1973 with the creation of the Tidewater Transportation District Commission to serve Norfolk, Virginia Beach, Portsmouth and Chesapeake. In 1974, the Peninsula Transportation District Commission was established to serve Hampton and Newport News. The Tidewater District Commission has had an executive director only since January of 1974, and the Director of the Peninsula District began work in June of 1974. Neither commission owns any buses, yet the Tidewater Commission has 20 million dollars of federal and state money to purchase buses for the district. Part of the

money came from the state highway fund, and some of it from the general fund. Although the state highway money was given on the grounds that a highway project would have to be deferred, this requirement is understood to be in effect no longer, and proposals can be considered on their own merits without having to defer a highway project.

The Transportation District Commissions will own and operate the mass transit system for their districts, and they have the legal authority to set fares and schedules; the commissions are also responsible to DOT and the union for contracts entered into in acquring and operating mass transit. Cities, however, must pay operating costs for services they receive, and cities must assume contractual obligations to DOT and unions for expansion of services and equipment not initially included in the capital grant to the commissions (37).

Control of the transportation districts by the commissions, then, is not complete, since there is no way for them to require that the city expand services or equipment. Even if it were necessary for continued coordination of mass transit in a district, say, that one city expand its services, the commission cannot require the city to do so. Hence, the amount of money the cities are willing to commit to mass transit, and their control over the amount of services they are willing to provide can be a major constraint on developing regional solutions to transportation problems. Since federal and state grants for purchase of mass transit systems are relatively easy to get, the mere commitment of cities to regional transportation is in itself no real accomplishment at all. The establishment of regional transit systems, in fact, relieves cities of the necessity of assuming contractual obligations to federal and state governments, and to labor unions.

The real committment to regional solutions for resolving transportation problems, then, cannot be gauged adequately by the number of cities merely entering into a regional commission. Rather, the real test of regionalism will come when a need arises for coordination of expanded transportation services between the two commissions in Tidewater. If the analysis of increasing economic integration of Tidewater explained earlier is correct, then transportation coordination becomes a necessity. Economic integration of the two areas will create greater transportation demands. If these demands are not met, access to the regions will decrease and economic integration will be slowed. A developing area that includes five of the six largest cities in the state of Virginia cannot function both ways, i.e., to continue economic integration and population development without resolving transportation problems that are the result of development into densely populated areas. A specific problem related to economic integration that is considered to have major implications for transportation are the tolls on bridges.

In December of 1975, the tolls on the Hampton Roads Bridge-Tunnel connecting Hampton and Norfolk are scheduled to be removed; the tolls over the James River Bridge connecting Newport News with Isle of Wight also will be removed at the same time (56). The removal of the tolls is viewed by the economic interests in the area as being extremely important in breaking down a major barrier to economic development, but toll removal is also viewed as creating increased demand for transportation facilities by planners. Every report on the two regions has placed major emphasis on this likelihood, and whatever solution is chosen will be costly. One study in 1970 (11) reported that the costs of removing tolls would be from a low of 113 million dollars if no new facilities were built to a high of 356 million dollars if a third crossing connecting the two regions were built at a given point. Three other options were given. The low cost was in 1970 dollar figures and presumed increased congestion, as well as a decrease in the amount of interaction and employment—which would continue to add to the costs of doing nothing—between the regions.

It was also concluded, however, that a third crossing of Hampton Roads was "desirable in economic terms and required in transportation terms" (11, p. 49), even though the results of connecting the third crossing with the proposed North-South freeway would have serious effects on the area:

> Preliminary investigation of such a location indicated that it would be virtually impossible to construct a freeway facility without causing considerable property damage. The final location should be developed by a detailed location study capable of evaluating the engineering feasibility and the environmental impact the freeway would have on the area through which it passes (11, p. 50).

Given the costs of the third crossing, the admitted damage to property, and the time needed to build the bridge, surprisingly, no

mass transit alternative to the third crossing was proposed.

Possibly there are other solutions which might decrease the need for transportation altogether. One solution, discussed in Chapter III of this report, is the increased use of telecommunications as a replacement for travel. Since much of the economic growth in the Tidewater area is of banking and finance, such a solution may be appropriate in increasing economic integration, while minimizing the cost of transportation. It may be feasible, for example, not to build a third crossing, but to use mass transit in conjunction with telecommunications to decrease transportation demands. Such a solution would require a great deal of cooperation between governmental officials and businesses, and is dependent on the further development of telecommunications technology. Nevertheless, it may partially resolve some long run difficulties of increased demand because of toll removal, while aiding in the integration of Tidewater.

The removal of tolls may, however, force decision-makers in Tidewater to push for a solution that seems to alleviate some congestion, but not resolve the problem should there be, say, a continuing energy crisis. Congestion on the existing bridges will perhaps push the decision-makers to begin building a third crossing between the two regions in order to show citizens that something is being done, even though the results will come only in the future. Throughout this section there will be specific discussion of regionalism, localism, and metropolitanism in Tidewater, but first there must be **a few comments about regionalism in general.** Attempted regional solutions to problems by the federal government are not new, of course, but regional approaches to transportation problems differ quite often from region to region. Geography seems to be the primary way of defining an area, but areas which are so defined may be in fact so diverse in their economic interests that close cooperation would be impossible. In such cases, geographis contiguity serves to intensify competition and conflict between the areas. Other possible drawbacks of regionalism (discussed below) have not been fully evaluated by the federal government. It may well be the case that only local solutions for transportation problems are feasible, and that regionalism cannot work because vested interests will only permit programs that will not affect them adversely. Again, perhaps the whole idea of regionalism is so foreign to the American experience of government that the problems of implementation at the regional level generate more difficulties than the original problem. Effective regionalism in transportation is almost certainly going to require that the regional authority have the power to fully implement proposed solutions, and this requires that resources be available directly to the regional authority. State and federal grants to regions rather than local governments do, of course, provide an impetus for localities to support regional solutions; the proposed federal legislation to provide operating expenses as well as capital grants may go a long way toward enabling regional transit authorities to overcome localism. Attempted regional solutions are not likely to work unless regional commissions are given the resources and power to implement and enforce decisions. Some planners and citizens have seen this as the situation in Tidewater.

Proposed regional solutions on a commission by commission basis may also result in a proliferation of agencies that create another level of government not capable of effectively coordinating short range solutions or long range planning. In other words, regional proposals may not develop into metropolitanism. With regard to transportation, for example, a metropolitan solution would have to include not just solutions to immediate problems of moving people, but would also have to include such factors as land-use, settlement patterns, and future development of all modes and facilities for transportation. Regionalism may be a step in the evolution toward true metropolitanism in the future, but there is no evidence that this is currently true in the United States. The proposed Unified Transportation Assistance Act (UTAP) that is now before Congress will definitely require regional transportation systems, but without a federal land use planning act metropolitanism would not be present.

Regionalism itself may or may not be the solution to transportation problems, but data on regionalism itself need to be systematically collected and evaluated before regional solutions are finally determined to be the only possible ones for all areas throughout the country (2). If our conclusion that *transportation decision making is generally made on the basis of no one being in charge, regionalism could be the key to overcoming this problem.* With only partial powers, and without adequate resources, regionalism may, at best, resolve partial problems in a way that is least expensive for local areas, but it does not achieve a coordinated and adequate solution. Close attention to the developments in Tidewater could provide data

on how effective regional solutions can be in overcoming localism.

Transportation Regionalism in Virginia

As mentioned previously, legislation requiring a regional solution to mass transportation is of long standing in Virginia, but it is only recently that transportation district commissions have been formed. Comprehensive Planning District Commissions, each of which includes a division on transportation planning, were established prior to the formation of Transportation District Commissions. The planning commissions are the equivalent of Councils of Governments in other areas. They can plan but not implement. The powers of the planning commissions come from the A-95 review procedure. The Transportation District Commissions are seen as the implementing agencies for planning commissions, and, since the transportation district commissions and planning district commissions are beginning to hold joint meetings in Tidewater, these groups could serve as needed links to coordinators of transportation policy in the area.

A major impetus for regional transportation solutions in the state has come from the 1969 study by the staff of the Virginia Metropolitan Areas Transportation Study Commission (15).

The Study Commission reported on urban transportation throughout the state, and alerted the state and local officials to problems of major concern. In assessing transportation in the Southeastern region in 1969, for example, one conclusion was as follows:

> The numerous political jurisdictions in the Southeastern area tend to hinder transit operations to a greater extent than anywhere else in the state. In many instances, one carrier transports transit riders to a political boundary and riders have to transfer to a bus of a different company, which is causing delay and extra expense to the rider. This discourages ridership and produced poor economics. A solution to the problem, i.e., the "Elizabeth River Ring" concept, has been discussed. The concept would allow buses to continue through the different political jurisdictions while making a loop of the area. The different companies would be allowed to dispatch their buses in an equitable way depending upon the size of the company. Many of the bus owners have expressed doubts as to whether the concept would work in actual practice and as long as fragmented regional control exists, a solution to this problem would be difficult to implement (21, p. 9).

. . . "Let the jury consider their verdict," the King said, for about the twentieth time that day.

"No, No!" said the Queen. "Sentence first—verdict afterwards."

"Stuff and nonsense!" said Alice loudly. "The idea of having the sentence come first!"

"Hold your tongue!" said the Queen, turning purple.

—Lewis Carroll

We note here the emphasis on a regional solution to a common problem, but we also note that it was several years after the report that a regional commission was even formed for the Southeastern region.

Changes at the state level have occurred since the 1969 study commission report was issued. The Highway Department has been changed to the Department of Highways and Transportation, and while the information given the authors of this report is that the change is in name only at the present, we also learned that the highway commission is supportative of mass transit. The commission has, as mentioned, provided funds for the Tidewater Transportation District Commission. The chairman of the state legislature's Roads and Internal Navigation Committee is still an advocate of highways, at least to the extent of advocating that funds for mass transit should come from the general fund and not the Highway Trust Fund.

The joint Hampton Roads Transportation Commission has also produced, in conjunction with the State Highway Commission, the study on toll removal mentioned previously (12).

State legislation has also provided a possible way that regionalism could eventually progress into metropolitanism in Virginia. In 1968, an act was passed that allowed cities to combine into service districts. The service district would have the power to plan, implement and tax for given services. No region has yet established a service district, and such a solution is not likely to achieve much support in Tidewater in the near future, but development of regionalism could demonstrate the feasibility of eventually moving beyond regionalism through the establishment of a service district.

Political relationships in transportation can be better understood by summarizing part of the statutory framework within which transportation decisions are made in Tidewater. A presentation of the important powers of Virginia's two regional agencies concerned with transportation appears in Appendix I.

The primary encouragement of regional planning and control of transportation in the U.S. is Section 9 of the Federal-Aid Highway Act of 1962 (35), codified as 23 U.S.C. §134. Federal-Aid highway projects in urban areas of more than fifty thousand population are required to be "based on a continuing comprehensive transportation planning process carried on cooperatively by states and local communities..." (35). The Unified Transportation Assistance Act of 1974 (36), legislation introduced in 1974 by the Nixon Administration, would establish the Unified Transportation Assistance Program (UTAP). Requirements for a "continuing, cooperative, and comprehensive planning process" for both highway and mass transit aid are contained in Section 212 of the Act. (For a discussion of urban mass transportation legislation, see Appendix H.)

Based on the report of the Virginia Metropolitan Areas Study Commission (32), the Virginia Area Development Act (37) was passed in 1968. This legislation provides for the establishment of Virginia's twenty-two Planning District Commissions, which have responsibility for the regional planning required by federal law (44).

A more flexible legislative measure pertaining to transportation is the Transportation District Act of 1964 (38), which does not provide for a fixed number of districts, but allows for enlargement (39) of districts as well as withdrawal (41) by counties and cities.

Finally, the Virginia Area Development Act provides, in addition to the creation of Planning District Commissions, for their possible evolution into service districts having broad governmental powers (the provisions are aimed primarily at sewage disposal and water supply systems): "Upon its creation, a service district shall be a public body politic and corporate and shall be deemed to be a public instrumentality, exercising public and essential governmental functions..." (42).

While the purpose of §9 of the Federal-Aid Highway Act of 1962 is to insure urban coordination of highway and other transportation planning rather than to promote the implementing power of affected planning agencies (45) (the Planning District Commissions have no power to "affect the powers and duties provided to local planning commissions by law") (40), promotion of regionalism and enhancement of the regional commission's influence may nevertheless be the results of §9's regional planning requirement. *In a word, there now exists an agency having concern with how a political unit's transportation system affects its neighbors.*

III. Transportation Decision-Making in Tidewater: Overall Considerations

When the investigation of Tidewater transportation decision-making began, several hypotheses about regionalism and decision-making were developed. Because of preliminary readings and discussions, the Tidewater region was divided into two sub-regions, and the question that arose was whether the same situation prevailed **within** each sub-region. It was also suggested to us that attempted regionalism in other areas often had collapsed into competition and localism. The investigators then set out to determine to what extent, if any, localism prevailed and to consider the possibilities for regionalism in transportation policies and economic integration. There was also no evidence that a power-elite controlled transportation, or that there was much real interest in a coordinated transportation solution outside the planning agencies and elected officials.

"What do you know about this business?" the King said to Alice.

"Nothing," said Alice.

"Nothing whatever?" persisted the King.

"Nothing whatever," said Alice.

"That's very important," the King said.

—Lewis Carroll

The investigators also wanted to determine whether the decision-making process was improved by having transportation decisions made by commissions composed almost entirely of elected officials rather than by appointed ones. Additionally, the investigators wanted to determine whether the conclusions of Lupo *et al.*, in their study of decision-making in several cities, were paralleled in Tidewater.

> Transportation decision-making takes place in a metropolitan political structure. This structure—it cannot be called a "system"—is

characterized by (1) an absence of public or private leaders concerned with the whole urban area, (2) the consideration of issues only when they reach a crisis and only when they do not directly threaten the serious loss of autonomy by municipalities, (3) a tendency of the individual units to compete rather than cooperate with each other, and (4) a tendency of the suburbs to hold the central city in suspicion, which is often exacerbated by differences in dominant party, ethnicity, and other divisive factors (8, p. 204).

Since adequate transportation will likely be tied to land-use and settlement patterns, it was also considered important to gauge how successful comprehensive planning had been in Tidewater, and to evaluate planning and polocies of the regional planning district commissions.

The possibility of true regionalism for transportation systems in both districts is difficult to assess at this point, since the Tidewater District Commission has been in operation only a little over a year, and the Peninsula District Commission has been formed only recently. For both districts, the immediate concern has been to purchase bus systems so that some public transit facilities will be available to the districts.

In the Peninsula District, composed of the cities of Newport News and Hampton, the private bus service was going out of business when the district commission was formed to buy it, and in the Tidewater Transportation District, composed of Norfolk, Chesapeake, Portsmouth and Virginia Beach, only Norfolk had purchased the private bus company serving the city (1972). While Norfolk is a member of the Tidewater Transportation District, the city has not agreed to sell its bus system to the Commission. Norfolk wants guarantees that they will receive the same service without additional costs, and there are some officials in Norfolk who seem to want to maintain their bus system separately from the Commission (and, in fact, to supply bus service at cost to the other cities in the area). Norfolk now supplies bus service at cost to the city of Virginia Beach. Since Norfolk has the hardware, they could continue to supply service to Virginia Beach and other regional cities.

Other cities in the Tidewater Transportation District Commission are more interested in supporting the Commission in the ownership of buses since they do not now have their own transportation system. Virginia Beach, although it is the third largest city in Virginia in population, never has had public transportation. Combining into a regional district commission cities owning their bus systems with those that do not may cause problems, and given the geographical, social, and economic diversity within the Tidewater Transportation District, the problems are compounded immensely.

As mentioned previously, Norfolk is a core city with little room for industrial expansion, while Virginia Beach is a bedroom city for Norfolk—34 percent of Virginia Beach residents work in Norfolk. Virginia Beach is also an agricultural center with another 38 percent employed in some form of agriculture, while the beach area is a major tourist attraction for the east coast. Virginia Beach is also one of the largest cities in geographical size in the nation, and simply integrating such diverse interests within one city would seem to present enough problems in itself. The fact tnat Virginia Beach was formed about 10 years ago to keep the city of Norfolk from incorporating the area points up the localism which created difficulties with regional solutions to transportation problems. Because it is a new city, Virginia Beach also lacks a good road network. It has to develop highways along with mass transit.

Chesapeake is primarily an agricultural area, and like Virginia Beach, is also one of the largest cities in geographical size in the country. The largest city in geographical area is Suffolk, which is included in the Southeastern Planning District Commission, but is not a member of the Tidewater Transportation District Commission. Portsmouth, the fourth city in the transportation district, resembles Norfolk in its economic and geographical composition, and the transportation commission is now in the process of acquiring 100 buses for Portsmouth. There are likely to be difficulties in combining such heterogeneous areas within what is supposed to be an urban transportation system unless a significant cooperation if forthcoming.

Knowledgeable people in Tidewater view Virginia Beach as being the most uncompromising in resolving regional problems. If this is true, it may be the result of trying to incorporate diverse economic and social groups into one group with similar goals. Virginia Beach is also expected to become the largest city in Virginia by the year 2000, and this development may lead to an unwillingness to

cooperate fully in a regional transportation solution that might bestow benefits on neighboring cities' ability to gain or maintain population and industry. In all fairness, officials of Virginia Beach do assert that regional cooperation and coordination are necessary, and Norfolk has been unwilling to grant right-of-way for limited access highways to Virginia Beach, as mentioned before. The solution to the problem presented by the diversity of Virginia Beach perhaps could have been the incorporation of part of the city into Norfolk at one time, but that solution was not politically viable. State legislation enabling the establishment of transportation districts does allow for establishing districts that encompass only parts of a political unit, and future solutions to transportation problems might well have to split the district into divisions that encompass only the high density areas.

Decision-Making in the Tidewater Transportation and Southeastern Planning District Commissions

The development of mass transit in the Tidewater Transportation District, like so many other places in the country, resulted from the failure of private transportation systems and the recent energy crisis (57). For the most part, the resolution of transportation problems has followed the principle of least action: nothing was done until it was necessary to do so. Even now, the response still lacks the concerted effort that will be required should the energy crisis take on major proportions in the future. Very little consideration seems to have been given, too, to the problems that are likely to occur when tolls are removed from the bridges now connecting cities in Tidewater. Since approximately 6,000 workers from each side cross to the other each day, tolls between the two cities have encouraged the development of car pools and the purchase of buses by individuals. Once the tolls are removed, so will the incentive to carpool or to ride a transformed school bus, thus increasing the use of the bridges and surrounding streets. Business groups do want to remove this barrier to economic integration between the two areas. Thus far, however, little attention has been given to mass transit as an alternative for modifying demand, once the tolls are removed. A regional solution to transportation will require coordination of mass transit in an effort to compensate for toll removal, but the coordination cannot wait until a crisis occurs if solutions are to be found.

The investigators have been unable to find business groups, civic organizations, or user groups which can privide an impetus and support for improvements and expansion of transportation. There is an elderly citizens group which is pressing for specific programs, and the League of Women Voters concerns itself with specifics. Private leadership advocating transportation that goes beyond meeting existing needs could not be identified for the Tidewater Transportation District. The Chamber of Commerce in Norfolk does have a transportation committee that has been effective in transportation development. Central Business District (CBD) businessmen have not provided the impetus toward mass transportation in the Tidewater Transportation District.

The major employer in the area, the Norfolk Naval Base, recently has become involved in trying to alleviate transportation problems created by having 40,000 employees massed in one area. The Naval Base's survey of transportation preferences has provided data that can be beneficial in planning for future needs, and in aiding in the decisions about the type and needs of transportation in the Tidewater District. Naval base workers were found to prefer mass transportation to carpools. This finding could be instrumental in getting decision-makers to disregard the beliefs held by some in the Tidewater Transportation District that only those who must ride mass transit will do so, and to promote transportation that will be adequate for those without automobiles, as well as for those who can afford private transportation.

A city or area that plans transportation only for those who cannot afford mass transit is planning for failure. A system that serves only those who do not have money or resources will result in a duplication of the failures that confronted private ownership. While it is too early to assess how far beyond bare essentials the Tidewater District Commission will go in developing transportation, it seems likely that the elected officials, planners, and the Naval base will have to serve as the impetus for new programs without a great deal of assistance coming from civic organizations or user groups (17).

The District Commission staff is trying to develop citizen inputs by contacting civic organizations of all types, but the response so far has not been great, probably because the groups being contacted do not include those who will ride the buses at the present time. It must be stressed again and again that **the real test of whether or not a transportation system will be successful is the willingness of the local citizens to plan and pay for services**

beyond those required to get the initial grant from the federal government. If present Department of Transportation policies do not serve to stimulate local governments and regional transportation systems to expand services to fill voids and constantly improve services where needed or beneficial, then the policies are failures and do nothing more than create temporary solutions that may even discourage long-range solutions.

In order to try to get increased inputs from groups who presently use the buses and to reach all potential users, new programs must begin with the onus that more is required to attract potential riders than merely contacting citizens groups and holding public hearings. The Toledo Transit Company offers cash and merchandise prizes to transit riders (20). This has the effect not only of stimulating riders, but also of getting CBD businesses involved in transportation problems and solutions. The development of neighborhood centers for transportation information, promotion, and participation also need to be developed in Tidewater. Elderly citizens' groups and civic organizations could be utilized in the operation of the centers, thus incorporating interested groups into the decision-making structure. User groups, formed into advisory bodies, should be employed also.

The Tidewater Transportation District Commission is composed largely of elected officials, but there are some on the commission who are not elected. An expansion of the commission to include representatives of user groups as voting members can serve to insure that participation by citizens directly affect decisions about transportation policy, not merely about specific routes and services. If citizen participation is encouraged only to the extent required by state and federal legislation, a major opportunity for participatory democracy will be missed. Once citizen groups see that they can have a major role in decision-making, potential opposition often turns into that support necessary in any region developing mass transportation.

In Tidewater, as elsewhere, too many decisions are likely to be made by people who are not themselves users of mass transit. An advisory body can aid in the identification and attempted resolution of problems before a crisis arises by people who are aware of the problems. Decisions made and then simply presented for ratification through public hearings, where little can be done to change them, can result in the growth of opposition groups. Often, the use of time and effort that can be devoted to constructive work is diverted to overcoming opposition. Regional transportation in the Tidewater Transportation District is going to be difficult enough without imposing additional burdens of creating opposition groups through inadequate opportunities for participation.

Besides the Tidewater Transportation District Commission members and staff, the Southeastern Regional Planning District Commission is also involved in transportation decision-making. The primary power of the planning commissions comes from the fact that they are the A-95 review agency of the region. More than one planner has voiced the opinion, however, that if the agency were not required by law in order to get federal and state funds, it would not exist. Since the planning district commissions cannot implement programs, the power of the planners is likely to be much more limited than the power of the transportation commission. When, and if, transportation planners begin to infringe on land development patterns, transportation politics become more involved, and opposition from localities is expected to occur. But if the Tidewater Transportation Commission, and the Tidewater area as a whole, are to move beyond localism into coordinated regionalism, then land use, settlement patterns, mass transit, and general transportation will have to be integrated. The investigators cannot fine realtor groups in Tidewater concerned with mass transportation. The standard pattern is to rely on highways, and if transportation policies are to aid in determining land use, realtor and developer interests are likely to conflict with transportation planning. Since the Southeastern District has a great deal of land to be developed, a rational plan would be to incorporate mass transit planning into development, even to the extent of requiring developers to set aside money to be used for mass transit expansion into new areas. The difficulties of implementing such plans are obvious, but the opportunity and the need are present. Planned expansion in conjunction with transit development would also be a demonstration that policies promotion regionalism might work to create mass transit that is metropolitan in nature.

The Peninsula Planning and Transportation District Commissions

The Peninsula Region extends from Hampton in the south to James City County in the north, but the Peninsula Transportation Dis-

trict Commission includes only Hampton and Newport News (58). Since these two cities are much more alike than the ones in the Tidewater Transportation District, their logistical and political problems in integrating transportation are likely to be less severe. The two cities have been served by the same transit company and both cities realize that there must be a common solution to their transportation problem. The Transportation District Commission arose out of the failure of the private bus company serving the two cities. The impetus for building an adequate transportation system, as in the Tidewater Transportation District, comes from the politicians supported by the business and civic organizations. Neither labor unions, users, nor realtors have been involved in promoting transportation innovations.

The Newport News Shipbuilding and Dry Dock Company has been involved with transportation problems since 1961, and the company has provided subsidies to the bus company for running buses from shopping center lots where cars can be parked, in order to take the bus. The shipyard has also provided close-in parking for carpoolers, and has purchased additional land for use as parking lots. Of all the employers in Tidewater, the shipyard has done the most to try to provide the workers with alternatives to the use of the automobile, and since the shipyard employs 26,000 people, they will have a major impact on the solution to transportation problems on the Peninsula.

The organizational structure for the Peninsula Transportation Commission is like that of the Tidewater Commission. The Commission is much newer, and the Executive Director was hired only in June, 1974. The Peninsula Commission is now involved in obtaining a capital grant for purchase of the private bus company.

The Peninsula Transportation Commission is also far less along in thinking about ways to get citizen involvement in transportation decision-making than is the Tidewater District. As far as can be determined, they have given very little thought to citizen involvement. Business and civic organizations have some input through the newly established Chamber of Commerce Transportation Committee which is concerned with both commercial transportation and mass transit. Membership on the committee is not representative of the users of mass transit, but there do not seem to be organized user groups on the Peninsula similar to those in the Tidewater District. There also does not seem to be much concern on the part of national organizations such as the Sierra Club about transportation in the Peninsula or Tidewater. None of these groups is directly represented on the Transportation Commissions. Most of the users, businesses, and civic organizations are not aiding in the crucial formulation of transportation policies. They are simply reacting to directions from the elected officials and transportation commission and staff. Policy decisions, then, are being made by the people elected to make them rather than by a power-elite, but the decision-making process is still far from pluralistic.

Another major difficulty in the Peninsula District, as in the Tidewater District, is whether or not the decision-makers are willing to establish an adequate transportation system, or whether they will be content with merely providing some type of mass transportation. The city councils of each city have approved a five-year plan for transportation, but the costs of the plan have not been made public. As a consequence there is no way of knowing whether or not there will be public acceptance for transportation planning that goes beyond acquisition of buses by funds coming primarily from the federal government. About 15 percent of the population in the Peninsula Transportation District now ride buses, and about 15 percent of the population do not have cars. In the Peninsula, as elsewhere, without increasing ridership to include non-captive riders, political interest in an adequate transportation system is likely to wane once the crises produced by a failing bus company or a shortage of energy have subsided.

The Peninsula Transportation Commission will also have to face the problem of correcting misinformation about citizen preferences. In the Peninsula District, as in the Tidewater District, there are those who believe that carpools are preferred to mass transit. Such beliefs are often held despite evidence to the contrary (17), and also serve to sustain a self-fulfilling prophesy that mass transit cannot attract users who have other choices. An inadequate transit system, of the type the Peninsula has had, which lacks even such rudimentary services as schedules, properly marked stops, and shelters, can hardly expect to attract riders. In the Peninsula region, as in the Tidewater Transportation District, *pro forma* public hearings are likely not to be beneficial in attracting participants who can share in the shaping of goals and making decisions.

Citizen participation in making decisions has not been typical in transportation matters,

yet the most feasible way of involving users is to insure them that they can influence decisions about transportation. An attempt to involve citizens is best directed, at this time, toward neighborhood groups. There is no guarantee that a neighborhood plan will prove more fruitful in involving citizens directly in transportation, but if not, elected and appointed officials will have genuinely tried to involve citizen groups. If neighborhood groups cannot be used to involve citizens, the channel for decision-making will have to be through elected political officials and the transportation director and staff alone. Such a procedure may be the only possible way to involve citizens in decision-making.

The information and impressions which the authors of this report have received are that the Peninsula Planning District Commission has been more of a ratifying agency for local governments to get money than a regional planning agency involved with coordinating area development. Some of the planners in the Peninsula area have explicitly expressed a strong belief that the regional commissions were developed to serve local government. The belief that the federal government is impeding the development of localities and regional planning by excessive requirements was also expressed more frequently among Peninsula planners than among those in the Soutneastern Region. City planners in one city of the Peninsula have been holding extensive public hearings trying to get citizen participation and there has been a citizens' committee concerned with one of the major transportation problems—Mercury Boulevard—for some time. The committee, however, does not seem to be overly instrumental in resolving difficulties. The cities in the Peninsula Transportation District have also been involved in trying to eliminate some of the major traffic bottlenecks in the city, and while citizens have been invited to participate in public hearings to discuss the problems, transportation planners have not moved beyond such hearings to involve the citizens in all aspects of transportation.

The Peninsula Chamber of Commerce has supported mass transit, but there is no indication that they have been an impetus for planning new approaches to transportation problems. The Peninsula Chamber of Commerce, like the ones in the Southeastern Regions, has been primarily interested in getting Interstate 64 completed.

At the beginning of this discussion of Tidewater, some conclusions found by Lupo's (8) studies of transportation in several different cities and areas were listed. The present study has found that, in general, the situation in Tidewater is still characterized by localism, competition, and a lack of interest within the region itself or in the sub-regions as a whole. There are, to be sure, some who are involved in bringing integrated transportation not only to the sub-regions but to the whole of Tidewater. The general findings generally are applicable whether applied to the Tidewater area as a whole or to each of the sub-regions.

The other cities throughout Tidewater seem to fear dominance by Norfolk, creating a situation not unlike other areas not divided by water where the core city is viewed with suspicion, and where the surrounding cities serve primarily as residential areas with different goals and transportation needs.

If our conclusions about localism, the failure to include citizen inputs effectively, and the continuation of localism in Tidewater are correct, it is likely that the institutional structure of decision-making is not as important as it has been believed to be in the past. Lupo found that transportation decision-making in the cities he studied is often characterized by the dominance of non-elected decision-makers who were isolated from public control. In Tidewater, the planners at the regional level often see themselves as the servants of local government rather than of regional coordination, and the control of transportation has been in the hands of elected officials. Similarities of Tidewater to other regions of the country where the decision-making structure is different suggest that some way is needed to try to involve the citizen directly in the decision-making process, whether that process is dominated by appointed or elected officials. It may be suggested, however, that transportation policies are too time consuming, specific and complicated for most citizens, and that no structure will effectively incorporate citizens in making decisions. This hypothesis may be true, but it needs to be explored by decision-makers, and different types of decision-making structures need to be used and compared before a hasty conclusion is made. In Tidewater, some feel that transportation solutions have been slow in coming because there have been too many politicians involved, and that the participation of non-elected officials has not been extensive enough to overcome the problem. Perhaps the most effective decision-making structure is one that includes appointed and elected officials in ways that do not allow for dominance. This may be especially true if we eventually find that

regionalism is the best way in which long term decisions about transportation should be made.

IV. Tidewater Tomorrow

Although competition, localism and suspicion have been characteristics of Tidewater and the two sub regions in the past, factors that **can** lead to regional solutions may be developing. Day (23) indicated five factors which are involved in an ideal system for improving transportation:

> 1. A formally constituted intergovernmental council representing the major local governments involved.
>
> 2. Technically strong regional planning staffs maintaining working level partnerships with staffs of the public agencies concerned with liaison with the economic power structure.
>
> 3. Public awareness of the need for high-quality transportation and for the use of public funds to achieve such transportation.
>
> 4. An economic power structure, working through formally organized media, that serves as a prime mover in achieving cooperation among local governments, planning bodies, and civic organizations.
>
> 5. Civic organizations that stimulate the free exchange of information between the citizenry and the organizations responsible for planning and carrying out urban transport progress.

In each of the sub-regions, there are formally constituted intergovernmental councils representing the major local governments, but an intergovernmental council linking the whole Tidewater area would possibly aid in joining the sub-regions together. Since there are the beginnings of joint meetings between the two Tidewater Transportation Districts, this would be a good place to begin to form some type of intergovernmental body on an official basis.

Assessment of the second point is difficult because of the lack of time to study each planning agency in detail, but the investigators have generally found that the Southeastern planning staff is more likely to be interested in regional approaches than the Peninsula area technical staff. This is perhaps due to the fact that in the Peninsula region there are only two large cities, and the difficulties of including city and rural governments into a cohesive unit may be at variance with regionalism. There is the beginning of liaison between the planning agencies and the economic groups in the area through the committee structure of public and private organizations.

There is also the beginning of public awareness of the need for mass transportation. In a study by Simpson and Curtin for the Peninsula Planning District Commission in May of 1974, it was found that 91 percent of the sample agreed that "a good bus system is essential to the growth of the region" (19, p. IV-3). An overwhelming number of respondents also agreed that improving bus service was more important than building more highways, and only 5 percent of the sample would let the private bus company go out of business and not have public transportation (19, p. IV-3). Seventy-six percent believed, however, that school boards should be responsible for school busing (19, p. IV-3). In the Tidewater region as a whole, a survey sponsored by the Virginia Metropolitan Areas Transportation Study Commission, and reported in Appendix G, found that, in general, mass transit would be supported. It has yet to be determined, however, whether support for mass transit will go beyond a bus system that now serves primarily those who must use buses. Whether a mass transit system that connects the sub-regions and allows for more complete integration of the areas and accessibility by all to the recreational and historic attractions of the area cannot be determined. There is a definite committment by Tidewater citizens to achieving transportation for all, but it must also be noted that most supporters are not riders of mass transit, and once costs are ascertained for adequate public transportation, the present support may disappear.

While there is no concerted effort thus far to move toward programs designed to integrate transportation, all indications are that continued economic growth and integration will force the economic power structure to consider the long-range effect of such growth on transportation. There is also an attempt on the part of some civic groups to aid planning and transportation districts in getting citizen input into decision-making, but the degree of civic involvement is rather small. Announcements for a public hearing for the Tidewater Transportation District Commission in June of 1974, for example, were mailed to more than 140 civic and community organizations in four cities. Over 135 notices were also distributed to employees of the companies affected by the proposal being presented. The results were extremely poor in terms of turnout in that only

about eight people appeared for the hearing. Since this is a consistent pattern in Tidewater and throughout the country, once again, the emphasis is made that **new methods of identifying and incorporating interested citizens in decision-making must be developed.** Hence, an additional item must be added to Day's checklist for improving transportation: the inclusion of user and neighborhood groups into advisory bodies and of user representatives on transportation commissions could only aid in the making of decisions that include user needs.

Overall, then, **the sub regions of Tidewater and the Tidewater area as a whole are developing the possibilities for moving toward regionalism within and among the areas. What is needed now is a broad-based group which will come forward to formulate goals, develop long-range plans, emphasize the importance of including land-use and settlement patterns in developing adequate mass transit, and make decisions in the interest of the region, not localities or sub-regions.**

In discussing transportation problems and decision-making, a number of barriers to sub-regional and regional coordination have been pointed out. In breaking down these barriers, however, there are characteristics in each region that can be used to advantage in implementing a mass transit system. There is a railway line between Norfolk and Virginia Beach, for example, that might possibly be used as a mass transit solution. The Tidewater Transportation District Commission, through the Southeastern Planning District Commission, is now asking for funds for a feasibility study of this proposal. The system could possibly use dual-mode vehicles that operate on highways and fixed rail. There are, however, technical difficulties in developing this type of dual-mode, and some planners believe that the improvements of the railbed and grade crossings would render this proposal too expensive. The rail line would aid in moving people into and out of the planned Norfolk Gardens area—where Westinghouse People Movers will be employed—and would be useful in getting beach goers to Virginia Beach.

In Virginia Beach, at the present time, there are also limited parking facilities, and citizens are calling for more public parking. A mass transit system, using either single or dual-mode to Virginia Beach, could turn past failures in providing public access into an advantage for area residents and beach businesses and users. Some of the congestion that now occurs at the Hampton Roads Bridge-Tunnel because of beach goers could also possibly be alleviated by substituting mass transit for private automobiles.

A dual-mode vehicle would also have advantages in connecting the two regions in that it could be employed on rails or fixed guideways in one area, moved across the bridges on its own power and then moved on rails or guideways at rapid speeds. Such a system might be feasible because there are rail lines on the Peninsula side that could be used, too. In fact, it might be possible eventually to connect, say, the historical areas in the Peninsula with the planned Norfolk Gardens and the present Virginia Beach attractions so that travel from one site to another can be done without leaving the vehicle or having to cope with the expected increase in congestion. If transportation in Tidewater is to be adequate in connecting the sub-regions, **a dual-mode system would seem to be the most advantageous and feasible.** If reliance is placed on buses alone, the bus system is likely to continue to cater to captive riders. Such a system may well be adequate for the present but there is the possibility of system failure resulting from either loss of support for the system, a gasoline shortage, or an increase in prices that will drive non-captive riders to mass transit. This would thus generate new demands and perhaps require major changes in the system. Long range planning for a dual mode system of the type described above can both solve short term problems and possess the flexibility for needed expansion and change.

One dual-mode system that has been adopted for Toledo might well be watched by people in Tidewater. The Toledo Area Regional Transit Authority (TARTA) recently took over the failing bus system in the city, and they have increased ridership by 23 percent through promotional methods that attract riders by offering cash or merchandise; merchants have also been involved by asking them to donate the merchandise. TARTA, despite its recent successes, however, anticipates a crisis in transportation by 1985, and has adopted a dual-mode system that will include features of the PRT, demand actuated response and rapid transit. (This system is described in Chapter II of this report.) Toledo does have a ridership and population density that can support mass transit, while Tidewater does not, but may well have in the future. If the system can be adapted to regions such as Tidewater, however, there are definite advantages in that it could aid in connecting the region without requiring special facilities.

The TARTA system might also be contrasted with mass transit developments in another city in Ohio in order to bring out the ways Tidewater might develop. In Cincinnati, Ohio, the bus system had to be taken over by the city in 1973. Fares were reduced to 25 cents, but there has been very little increase in ridership since. No new systems are being planned, no user or neighborhood groups have been developed; in short, this city has simply changed its system from private to public ownership, and there seems to be every indication that Cincinnati will once again fail to provide its citizens with adequate transportation. Moreover, this stagnation in the transportation systems has been followed by a general deterioration of the city and by reduced use of city facilities by regional residents. Toledo, on the other hand, is a growing and prospering region. There would seem, then, to be good evidence for a causal relation between city and regional developments and transportation.

Tidewater can go the way of Toledo and move ahead with programs of development, or it can follow Cincinnati and develop a bus system for captive riders only. Predictions about which direction Tidewater will take are hazardous, but a close look at Tidewater's decision-making structures could provide a sound basis for the intelligent management of future transportation developments.

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40. Va. Code Ann. §15.1-1405 (1973 Replacement Volume).

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Explanatory References

43. For a detailed discussion of the attempt of a citizens group to have some control over Cincinnati General, and the controlling power group's response, see Jerone Stephens, "Medical experiments on humans and the need for a public policy," in Matthew Holden, *Yearbook of Public Policy Research.* Sage Publications, 1974.

44. The Federal government encourages or requires regional planning in areas other than highways and mass transit; e.g., regional planning of river basin water quality management plans is a "Prerequisite to the receipt of federal construction grants." Note: Public Regulation of Water Quality in Virginia, 13 *William & Mary Law Review* 467 (1971).

45. The Senate Report on the Act declared that 7 directs the Secretary of Commerce (now Transportation) "to cooperate with the States in the development of long-range highway plans and programs coordinated with plans for improvement of other affected forms of transportation." *1962 U.S. Code Congressional and Administrative News,* p. 3938.

46. These designations correspond closely to those of the U.S. Bureau of the Census. The Census Bureau divides most of Tidewater into 2 SMSA's. Our Southeastern Region adds Suffolk to the Norfolk-Portsmouth SMSA and the Peninsula adds Williamsburg and James City County to the Newport News-Hampton SMSA.

47. As defined by the U.S. Bureau of the Census, urban residence includes all people living in: (a) places of 2,500 inhabitants or more; (b) other territory, incorporated or unincorporated, included in urbanized areas. U.S. Bureau of the Census. U.S. Census of Population: *1970 Number of Inhabitants,* Final Report PC(1)-A48 Virginia, p. IV. The reader should be aware that a given area may change from 100% rural to 100% urban if it becomes part of an urbanized area. Source: Serow and Spar, p. 26.

48. If the twenty-six thousand Newport News Shipyard employees were removed the 35.5 thousand total manufacturing employment in the Peninsula would drop to 12.2 percent from 22.2 percent.

49. The name of this committee was recently changed from Hampton Roads Area-Wide Committee to Hampton Roads Area Committee.

50. All 100 of the trustees of the Tidewater Virginia Development Council are appointed by the area majors, and the majors (or city managers) make up the government policy board.

51. Unlike the Tidewater Virginia Development Council (see reference number 50) the four contributing political units of the Peninsula do not control the area Committee. Each city has one vote which is the same as the 400 business members.

52. At the end of 1968, two Richmond based banks had a total of 17 branches in Norfolk, Virginia Beach, Portsmouth, Chesapeake, and Nwport News. By the end of 1973 *there were no* Richmond based banks with branches in Tidewater. *Operating Banking Offices,* January 1, 1969, Federal Deposit Insurance Corporation, p. 501-514; and *Operating Banking Offices,* December 31, 1973. FDIC, p. 605-622.

53. 1970 Population, U.S. Bureau of Census.

54. Newport News Shipbuilding and Dry Dock Company.

55. Tenneco is a conglomerate with total sales of over $4 billion in 1973 with almost one-half billion coming from shipbuilding. "Tenneco's new strategy: growing from within." *Businessweek,* August 3, 1974, p. 51.

56. This information was obtained from the director of toll facilities for Hampton Roads.

57. Information on the Peninsula Transportation District Commission is contained in reference number 13.

58. When discussing decision-making in transportation, there are too often charts showing how inputs affect outputs, rational choices of where decisions should be made, and so on. This discussion avoids such charts; for a discussion of why the input-output theory of politics is not useful, see the article referred to in reference number 30.

SUMMARY, CONCLUSIONS AND POLICY OPTIONS

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Chapter V

SUMMARY, CONCLUSIONS, AND POLICY OPTIONS

The preceding chapters have analyzed many of the historic, current, and future interrelationships between transportation and urban systems. An attempt was made to provide perspectives on mobility in urban areas and options which **determine** transportation choice as well as those which are themselves **determined by** transportation choice. The theme of change—change as inevitable but manageable—has been central in this report. The discussions of transportation technology, modal choice, and decision-making have indicated the complex connections between technological change, changing value systems, and the choices and policies emerging out of those shifting values. The future is one of expanding options; this report has attempted to make those options and their implications clearer.

Planning for Urban Change

From the beginning of recorded history, urban settlements have been shaped continously by technological and socio-cultural change. Major urban transitions have occurred when one or both of these forces were strongly evident When socio-cultural forces were dominant, key direction was provided for urban transitions, but when technological forces held sway, no direction was provided to urban change, and cultural crises and social chaos often followed. The world appears to be moving into a transition period in which technological forces prevail. The question facing man is: can he control his future, or is there no alternative to chaos?

Simple extrapolation of present trends in American cities results in gloomy prognoses for the future. Many urban environments are rapidly deteriorating as a result of the interplay of poorly-managed technological changes and vaguely understood socio-cultural changes. The use and misuse of transportation, in terms of man's dependence upon the automobile, his reluctance to support public systems, and his insistence upon individual mobility, have been major factors in the present climate of urban deterioration. As yet, there has been little effective action, or concern, to reverse this trend. On the other hand, there are some indications that the coming post-industrial era will be marked by, or at least have the potential for, orderly change rather than disorder and chaos. A new consciousness seems to be emerging, as evidenced by present concerns for man's common roots, increased awareness of environmental issues, and growing realization of the potential of planning. The outcome is far from clear, but the conflicts are intensifying, and the problems of urban transportation are one of many crucial battles that need to be enjoined.

During rapid social and technical change, established goals and value systems suffer severe strains leading to eventual disruption. Present day goals and values are no exception; almost all are undergoing "agonizing" reappraisal by both societies as a whole and by their leaders. For the industrial man, physical mobility long has been a means to social mobility. Now, however, the surfeit of physical mobility that characterizes American cities is causing a slow strangulation of the very social and economic opportunities that originally had made these cities magnets to the dispossessed, yet ambitious, surplus population from the farm and countryside. At present, the worst suffering is borne by the poor, the black, the old, and the infirm, all of whom share the common burdens of poverty and immobility. An ethic of competition for urban opportunities must be replaced by an ethic which will maximize urban opportunities for all. Only then will the strangulation of traditional urban functions and its consequent social inequalities be halted. This new urban ethic involves a greater commitment to social equity, urban opportunity, and resource conservation. In terms of transportation policies, the new ethic subsumes aspects of more efficient movement, more pleasurable movement, greater environmental concern, and more efficient resource use.

If the transition to the new post-industrial era is to be accomplished with a reasonable degree of order, man must be able to influence the technological and socio-cultural changes that are occurring. Planning is the management of change; thus, to a high degree, the planner carries forward the hopes of mankind. Planners and all those who make planning decisions are, however, subject to the constraints imposed by societal goals, personal philosophies, and available tools. Within the particular limits of each of these areas, planners generally are free to analyze, order, manipulate, and propose. Little effective action is possible outside these limits, and for this reason, it is useful to understand the constraints operating on planners in any given society. These constraints include the degree of centralized control society exercises over individuals, the personal assumptions and values held by the planner, and the types of planning models available for use. A knowledge of planning constraints existing in

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the urban transportation sector is necessary in order to define the overall range of feasible plans and to identify planning areas where new breakthroughs may occur.

Transportation Technology

Chapter II dealt with transportation technology. The discussion focused on the attributes of a number of existing and futuristic transportation modes and systems and concluded with two comparative analyses of the levels of resource consumption of these modes, with reference to both monetary and energy costs, and a proposal for a "composit system" which utilizes the outstanding and desirable features of a number of modes.

To summarize the discussion of the modes that were considered, it appears that in the next few years the immediately available modes of transportation will be the automobile, bus, and regular-track systems. Both the automobile and bus will be with us as far as can be seen into the future. Buses will undergo modernization and improvement while many changes may occur in the form and capabilities of the automobile. The size of the automobile can be expected to be reduced and new on-board power plants and sources of fuel should be considered.

Looking further into the future, it can be reasonably expected that Dual-Mode vehicles, capable of running on both existing street networks and separate automated rights-of-way will be available. When combined with the concept of on-demand Personal/Group Rapid Transit vehicles and with innovative management of highway vehicles on conventional highways, as in a dial-a-ride arrangement, a possible futuristic system emerges. This system may resemble the proposed Bi-Modal Transit Vehicle (BTV) now under consideration by the Toldeo Area Regional Transit Authority. The necessary attendant advances in computer technology probably will have taken place so that the vehicle can be put under computer control while on a separate automated right-of-way. Other technological innovations with potential for incorporation into the overall future urban transportation system also include magnetically levitated track systems, hybrid cars, and vertical take-off and landing aircraft.

An objective of transportation systems is to have an integrated system that will balance or complement the various modes in use. A system should not necessarily be uni-modal, but should be composed of different modes to handle different needs. The automobile will remain, in one form or another, the prevalent form of transportation, but it should be balanced with bus, rail, water, and air transportation. The exact mix of the modes will vary from region to region, and no exact description of a complete system can be given. Furthermore, the mix of the various modes will vary with time. With changes in technology, it may become advantageous for one mode of transportation to be replaced by another. These changes will occur and should be anticipated so that they can be integrated into the transportation picture with as little disruption as possible.

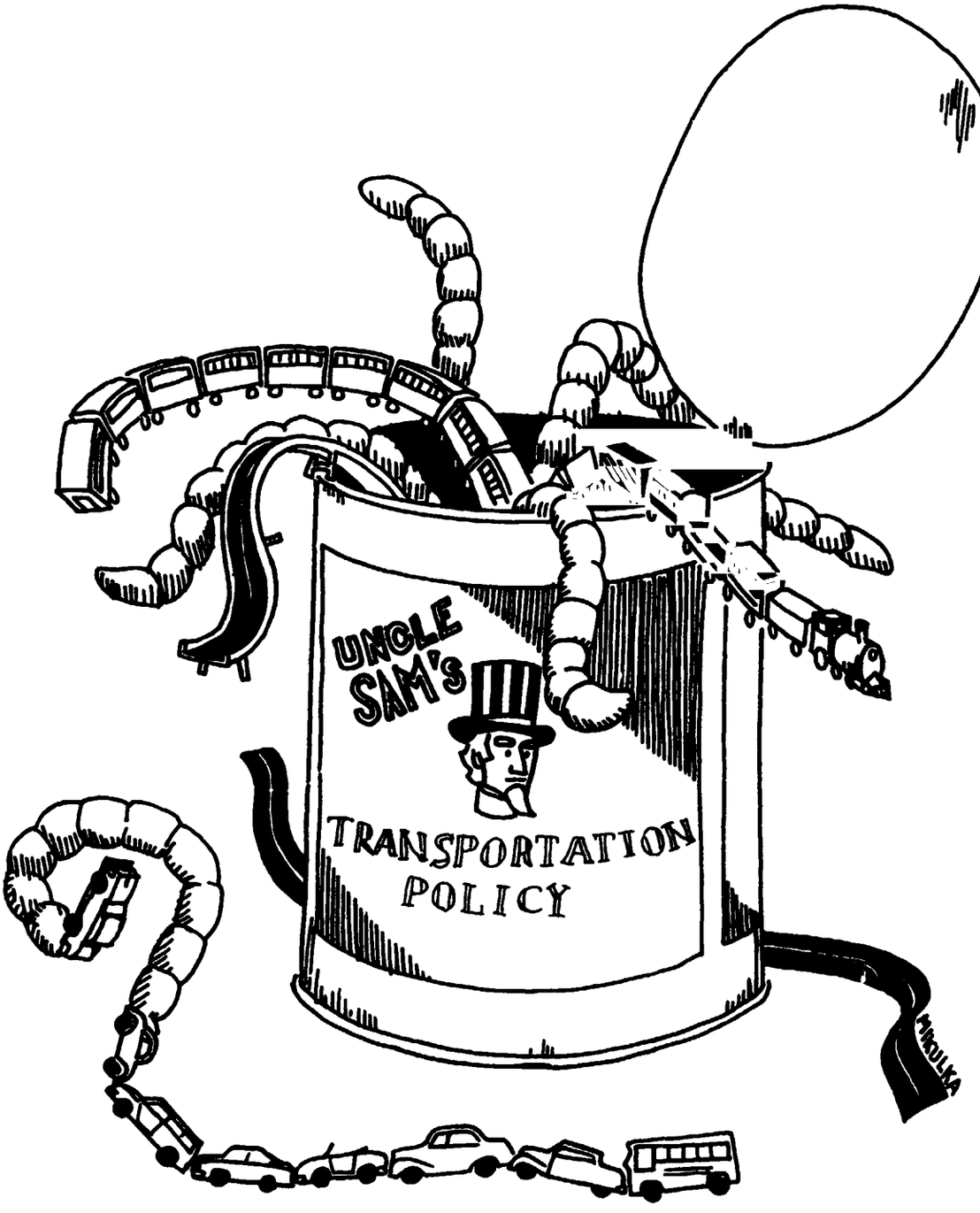
Transportation and Modal-Choice

Chapter III recognized the important role of the automobile in our society and suggested some non-hardware mechanisms for modifying the transportation system. A range of software proposals was presented for reducing the need for transportation in general and dependence on the private car in particular. These suggestions neither exhaust the possibilities, nor are any of them likely to be appropriate for all urban areas. However, they do represent a number of social and institutional approaches to transportation problems.

The chapter advocated that more attention be given to **human factors** in transportation. The car meets the **perceived** needs of people; mass transit does not. Mass transit is believed to be unsafe, crowded, uncomfortable, and degrading. These perceptions can be altered by changes in the design and operation of transit systems and through the use of mass media advertising, which has been used so extensively by auto proponents. Rider education programs were proposed as complements to driver education as a means of expanding information on the use of transit and overcoming some biases toward automobiles.

Another area of suggested change was substitutes for transportation. Land-use planning was proposed as a means of managing the direction of development and future transportation needs. Technological advancement in telecommunications, such as videophones and two-way cable television, were seen as attractive alternatives to transportation. More research is needed, but existing knowledge indicates potential savings of money, time, and energy. The potential for subsitution apparently depands on the cost and flexibility of terminal facilities.

While future changes may offer alternatives to transportation, existing transportation facilities can be used more effectively in the interim. Staggering work hours could do much to alleviate the peak-load problem of congestion during a few hours of the day


UNCLE SAM'S
TRANSPORTATION POLICY
MIKULKA

Modal choice between cars and mass transit, as well as the time-of-day and trip pattern decisions, could be altered to use society's resources better. It was pointed out that perceived private costs of car use are below actual private costs, and that actual private costs do not reflect the full social costs of the auto trip. A range of methods for correcting the failure of the market mechanism to force drivers to consider the full societal costs of congestion, pollution, and resource use was presented. These included expansion of information, congestion and pollution charges, parking taxes, and increasing the attractiveness of mass transit.

The final section of Chapter III examined legal problems associated with using transit vehicles for parcel delivery as well as passenger service. It also discussed the powers of municipalities in regulating and prohibiting traffic. Finally, it looked at the possibility of a "congestion tax" on employers in crowded areas.

Transportation and Decision-Making in Tidewater

While Chapter III dealt with human behavior and the psychology of demand patterns, Chapter IV concerned human behavior at the political level and proceded through an analysis of the decision-making process as it is applied to transportation systems. Starting from a broad view of decision-making, the analysis narrowed and focused on the Tidewater area of Virginia. Tidewater is a rapidly growing region composed of the area bounded by the Southeastern corner of the state and the Virginia Peninsula between the York and James Rivers. The region examined in the present study coincides closely, but not exclusively, to the two Standard Metropolitan Statistical Areas of Norfolk-Virginia Beach-Portsmouth, and Newport News-Hampton, Virginia. The area was used for a case study of transportation decision-making with special attention given to the debate over regionalism versus localism.

Regionalism has been adopted by the federal government as a way to attack transportation problems without convincing evidence that regional solutions work. No systematic criteria have been developed for assessing the failure or success of regional transportation systems, yet the present policy is to move ahead with more regionalism.

The advantage of regionalism is that it creates a central organization that can overcome local competition and lack of local formulations of long-range goals. The administrative, capital, and operating costs can often be reduced by a regional solution also. Regional administration can also include representation that can overcome the power elite of local jurisdictions, and the narrow base of representation that is often found on city councils, educational institutions, government advisory bodies, and so on. Coordination of transportation, land-use, and settlement patterns can be made best on a regional basis.

There are several disadvantages of regionalism that must also be considered. Regionalism can deter direct participation by citizens in decision-making by making the units so large and comprehensive that the complexity adds to natural apathy. Bureaucratic isolationism and budgetary control by the region can be oppressive on minorities which are not adequately represented. Centralization of powers and efficiency have been used in the past for such purposes, and there is suspicion by minority groups today that regional solutions are to be used to dilute the growth of minority power in cities, not improve services.

Requirements of federal governments that regional solutions be adopted by areas in order to get capital grants for transportation facilities, without providing for operating costs, can easily result in the continuation of minimal service. The creation of several regional commissions, each with different areas of authority, only shifts the problems of localism into regional commissions without resolving the problems created by local lack of coordination.

There are no easy answers to whether regionalism is, or can be, a better institutional solution to transportation or other problems. The need now is for systematic study of selected regions to determine whether a regional policy should be followed. The continuation of the federal government's promotion of regionalism, without developing criteria for assessing the results, may well result in the continuation of existing problems and the creation of new ones.

In examining Tidewater, the transportation problems within each subregion were considered with the area as a whole. Conclusions, based on extensive interviews, discussions, and past studies, should be considered within this dual framework.

The salient feature of Tidewater as a whole is that there appears to be a lack of any overall goals, strategy, or organization that could bring the area together. This characteristic led to the conclusion that the best way to think of Tidewater transportation integration and decision-making was in terms of the "no one being

in charge" model, one of three models discussed in the chapter. Various governmental and private organizations have been formed at various times for purposes of coordination, but none of these groups has been successful in bringing Tidewater together.

Within each region, past experiences have paralleled those found in others areas of the country and in Tidewater as a whole: a lack of effective coordination and organization which could propose solutions to regional problems. With the crises promoted by failing bus companies and energy, however, the subregions began to form transportation organizations which have the potential to bring together competing units into a coordinated whole, at least with regard to transportation. Other factors also intruded to propel the subregions and Tidewater area into searching for mutual solution. The proposed removal of bridge and bridge-tunnel tolls by December 1975, and the anticipated increase in transportation demands on the crossings, as well as the increasing amount of economic integration in the area, are major factors.

The present situation in Tidewater is such that the factors for achieving coordination are present, but no accurate predictions can be made about the direction Tidewater as a whole, or any subregion, will take. Difficult decisions about whether regional solutions are to be confined to individual jurisdiction or to Tidewater as a whole must be made shortly. The decision must take into account the existing diversity, interests and goals of each area, and guard against one group attempting to impose its values in order to prevent an impasse that will mitigate against regional solutions. Goals that might be adopted now seem to be of the types mentioned later in this chapter. Policies to implement the goals will have to be determined fairly quickly regardless of the types of goals that are chosen. Inaction will also be costly. Proposed costly solutions will have to be compared with the estimated costs of inaction.

Policy Options

During the eleven-week period of this design study, discussions of topic-related content among group members were characterized by argumentation and debate, coercion and compromise, and collaboration and consensus—characteristics of almost any multidisciplinary effort of this type. One primary difficulty was crossing disciplinary backgrounds in an effort to grapple with jargon. Another was dealing with the perplexing characteristics of a multidisciplinary approach. Although the report may not reflect the nature and extent of group interaction, or the ideas and sub-topics which were carefully considered then deleted, it should be viewed in that light.

Perhaps there was no area where discussion was so prolonged and intense as in the selection of goal and policy recommendations. This was the case for, perhaps, two reasons. First, because of different value sets, the direction and degree of goal/policy statements were difficult to accomplish; some goals discussed were mutually exclusive. Second, because of imperfect knowledge and incomplete data, the consequences of suggested courses of action were difficult to determine.

The moment Alice appeared, she was appealed to by all three to settle the question, and they repeated their arguments to her, though, as they all spoke at once, she found it very hard to make out exactly what they said.

The executioner's argument was, that you couldn't cut off a head unless there was a body to cut it off from: that he had never had to do such a thing before, and he wasn't going to begin at ***his*** *time of life.*

The King's argument was, that anything that had a head could be beheaded, and that you weren't to talk nonsense.

The Queen's argument was that, if something wasn't done about it in less than no time, she'd have everybody executed, all round. (It was this last remark that had made the whole party look so grave and anxious.)

—Lewis Carroll

Disagreements over goals and policies are not unique; they have been encountered by all groups which have attempted to deal with such transportation issues (see Figure 5-1). There is a basic lack of agreement on goals and policies for the nation and its urban areas; and, due to the absence of well-specified goals, meaningful guidelines for effective public policy are lacking. Since statements which often pass for federal goals are often generalized, vague, and sometimes contradictory, there should be no surprise that consistent policy cannot emerge from them. Often goals are enunciated or couched in phrases such as "balanced transportation systems," "adequate employment," "apropriate land use," "wise conservation of natural resources," and

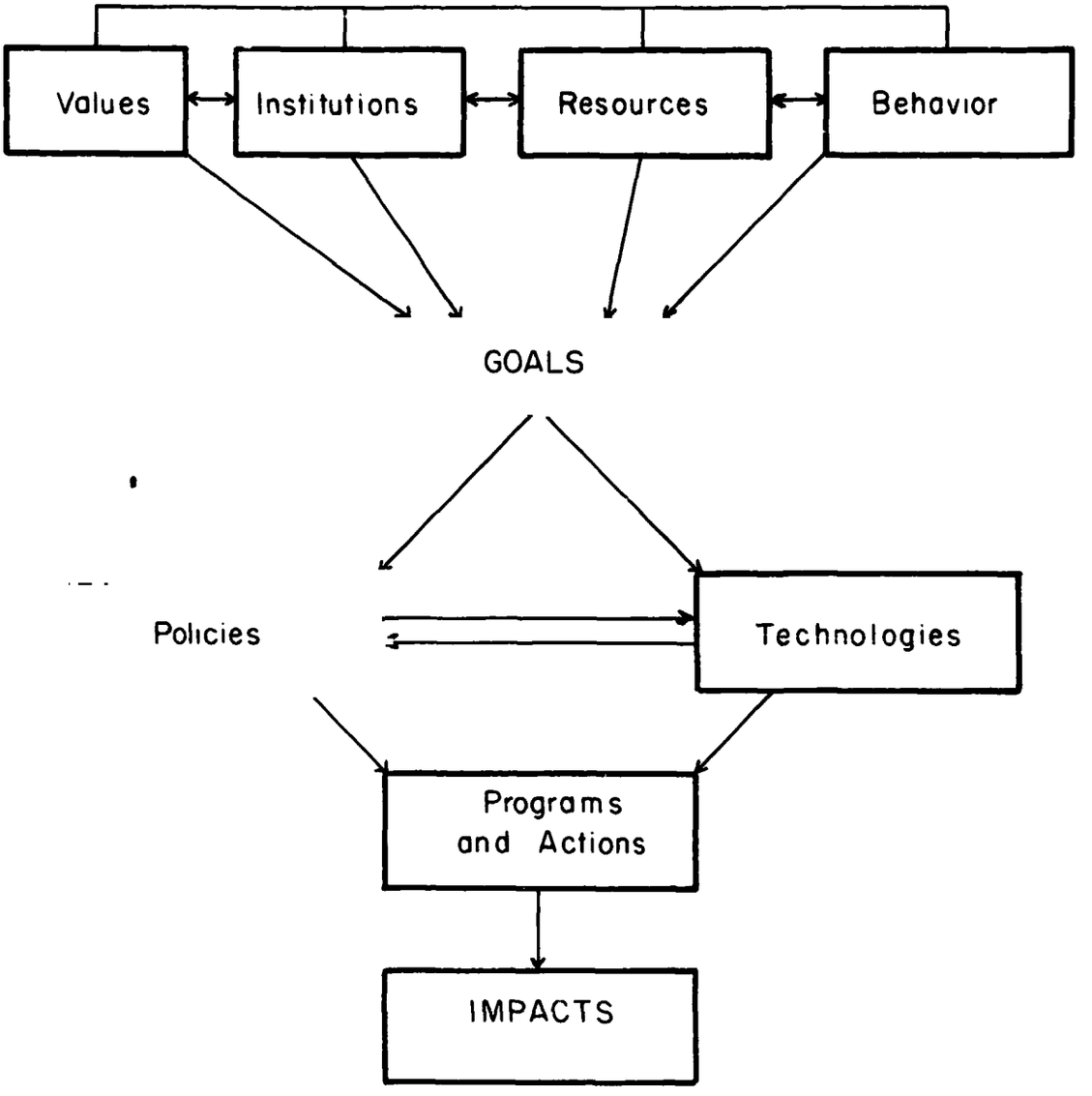


FIGURE 5-1
FRAMEWORK OF GOAL INDENTIFICATION
AND GOAL ACHIEVEMENT

generalized ideals, it is little wonder that these "goals" are often not translated into effective public policy.

In presenting recommendations here, three routes could have been followed. First, the route adopted by other national bodies: a series of broad, sweeping, general statements with which everyone could agree, but which would provide little direction to policy and decision-makers. Second, specific direction could have been provided to policy makers; however, value conflict coupled with unfamiliarity and incomplete knowledge of local problems by outsiders might yield recommendations which were inappropriate or misdirected for certain regions or levels of government.

Instead of either of the two alternatives above, a decision was made to provide the array of policy options in Figure 5-2 for the consideration of planners and policy-makers. There is no attempt here to impose values on others. The assumption is that those who must make decisions will find something of use in the array of recommendations which follow.

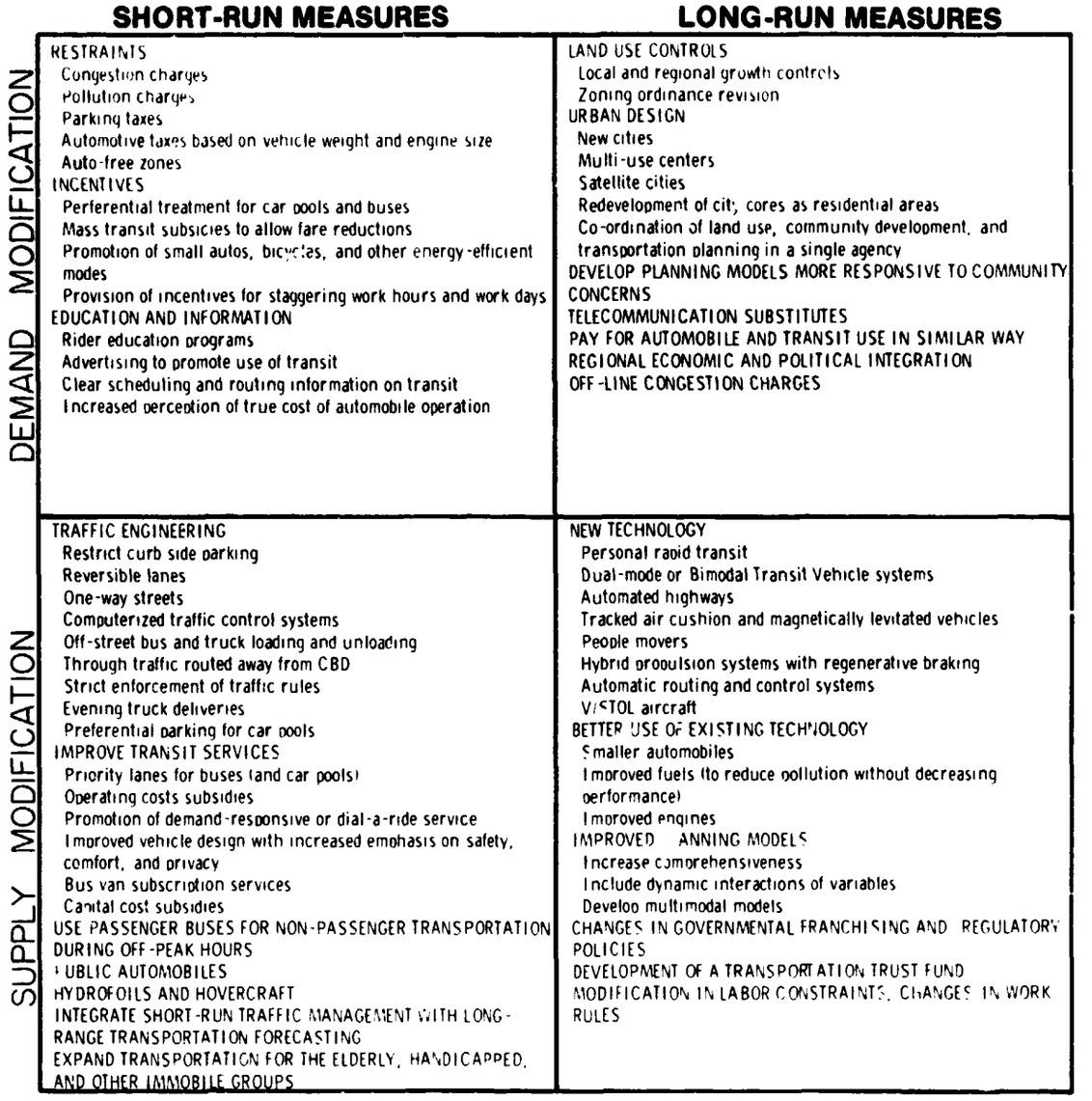


FIGURE 5-2
OPTIONS IN URBAN TRANSPORTATION

and will consider those which are appropriate for their governmental, geographical, or interest area. They represent a synthesis of recommendations made either by one individual team member, or which have emerged out of, and been supported by, the previous chapters. Although many of the policy options obviously overlap cells in Figure 5-2, each was considered and placed, somewhat arbitrarily, in a particular cell. There is by no means unanimous agreement on these policies. In some cases there was near-unanimous support; in other cases very little support.

Perfect solutions will always be elusive. One should not worry about achieving the best solutions, but should strive to achieve those which are optimum. Those who choose the options must recognize explicitly the goals they desire to achieve and carefully analyze the consequences of adopting any alternative solution. These policy options should provide a meaningful step in that direction.

APPENDIXES

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APPENDIX A

FACULTY FELLOWS AND ASSOCIATES
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APPENDIX B
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Date	Speaker/Affiliation/Topic
June 3	Mr. D William Conner, Head V/STOL Aircraft Projects Office NASA-Langley Research Center Hampton, Va. 23665 "Regional Transportation Planning Needs, Requirements, and Approaches"
June 4	Dr. Gary M Richetto Department of Communication and Organizational Behavior General Motors Institute Flint, Michigan 48502 "Decision-Making and Problem Solving in Multidisciplinary Groups"
June 6	Mr. Thomas B. Deen, Vice-President Alan M Voorhees and Associates, Inc. Westgate Research Park McLean, Virginia 22101 "Trends in Urban Transportation"
June 7	Mr John Sears, Chairman Virginia Metropolitan Areas Transportation Study Commission 1320 Harmott Avenue Norfolk, Virginia 23510 "Transportation in the Tidewater Area in the 1980's"
June 18	Mr. Robert L. Paullin, Division Chief Office of R & D Policy Department of Transportation 400 7th Street, S W. Washington, D.C. 20590 "Technical Resources in Transportation"
June 19	Mr. Richard M Cornelius, Attorney 13629 Warwick Boulevard Newport News, Virginia 23606 "Transportation and Land-Use Planning"
June 20	Mr Joseph Paulus, Transportation Planner 2017 Cunningham Drive Hampton, Virginia 23666 "Transportation Planning in the Virginia Peninsula District"
June 20	Commander Lee Carlson, Comptroller of 5th Naval District Headquarters for Naval District Comptroller's Office Naval Base Norfolk, Virginia 23511 "Development of a Public Transit System as an Alternative to the Automobile"
June 20	Mr Charlie M Floyd, Manager of Personnel Newport News Shipbuilding and Dry Dock Company 4101 Washington Avenue Newport News, Virginia 23605 "Attempts by Newport News Shipbuilding and Dry Dock Company to Overcome Transportation Difficulties"
June 21	Mr. David Krueger, Transportation Planner Southeast Virginia Planning District 110 W Plume Street Norfolk Virginia 23510 "Transportation Planning in the Southeast Virginia District"
June 21	Dr John Dickey, Director of Urban and Regional Studies Virginia Polytechnic Institute and State University Blacksburg, Virginia 24061 "Metropolitan Transportation Planning and Technology"
June 27	Mr. Jess Ross, Chief Management Supporting Division, and Mr Eugene Mason, Head, Energy Reduction Committee NASA-Langley Research Center Hampton, Virginia 23665 "Langley Research Center's Effort to Get Employees On and Off Base Durring Peak Hours"

June 28	Dr. Denos Gazis, Director of General Science Department IBM Research Center Box 218 Yorktown Heights, New York 10598 "Computers and Traffic Control"
July 1	Mr. Bill Snyder NASA-Langley Research Center Hampton, Virginia 23665 "Civil Helicopters"
July 3	Mr. Robin K. Ransone Engineering Science and Systems Thornton Hall University of Virginia Charlottesville, Virginia 22901 "Intra-Airline Transportation System in Virginia"
July 11	Ms. Jane Jacobs (Teleconference) c/o Random House New York, New York 10025 "Planning in American Cities"
July 16	Col. O. E. Hicks Peninsula Transportation Commission Hampton, Virginia 23666 "The Role of the Peninsula Transportation Commission"
July 18	Mr. Jack Schnell, Director of Research American Transit Association 475 L'Enfant Plaza West, S.W. Washington, D.C. 20024 "The Transportation Decision-Making Process and Labor/Jurisdictional Issues"
July 25	Dr. R. Buckminster Fuller 3508 Market Street Philadelphia, Pennsylvania 19104 "Transportation in the City of the Future"
August 5	Dr. Frank Colcord, Chairman Department of Political Science Tufts University Medford, Massachusetts

APPENDIX C

ACKNOWLEDGEMENTS

Appreciation is expressed to the following persons and organizations for providing material, information, and assistance. These individuals and organizations are not responsible for any inconsistencies or reportorial errors that might be found in this document.

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APPENDIX D
ORGANIZATION OF THE DESIGN TEAM

A. Preliminary Study

To attain the goals of the project within an eleven-week period, the design study was organized into various phases. Initially, participants were divided into two basic groups for preliminary study:

Group A (Transportation Demand)	Group B (Modal Supply)
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C. M. Brooks	W. E. Cobb
N. H. Erb	J. E. Cross
C. F. Fromme, Jr.	J. C. Ficht
D. D. Harmata	L. G. Keeter
V. J. Stephens	E. E. Niemi, Jr.
A. Van Gelder	D. Warner
W. D. Wilson	P. H. Wojciechowski
P. R. Wozniak	

B. Group Assignments for In-Depth Study

Following two weeks of preliminary investigation, the design team organized itself into five task groups:

Task Group I (Tidewater Questionnaire Analysis)

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J. W. Bird	T. W. Mason

Task Group II (Urban Transportation Modes)

C. F. Fromme, Jr., Chairman	E. E. Niemi, Jr
J. W. Bird	V. J Stephens
J. E. Cross	W D Wilson
L. F. Darby	P. H. Wojciechowski

Task Group III (Transportation Demand Modification/Modal Choice)

W E. Cobb, Chairman	J C. Ficht
G R. Arnold	D. D. Harmata
J. W. Bird	T W Mason
L. F. Darby	A Van Gelder
N H. Erb	D. Warner

Task Group IV (Transportation Decision-Making)

V J. Stephens, Chairman	L G Keeter
G. R. Arnold	T W Mason
W E. Cobb	A Van Gelder
J E. Cross	D. Warner
N H. Erb	P R. Wozniak
D D Harmata	

Task Group V (Ideal Cities)

P R Wozniak, Chairman	A. Van Gelder
C M. Brooks	D Warner
L F. Darby	W. D Wilson
T W Mason	P H. Wojciechowski
E. E Niemi, Jr	

As the project evolved, new areas needed to be investigated, and as a result, one new group was formed.

Task Group VI (Transportation and Urbanization)

D. Warner, Chairman	L. F Darby
C. M. Brooks	P R. Wozniak
W. E. Cobb	

C. Chapter Coordinators

As efforts of the Task Groups neared completion, their results were incorporated systematically into the major sections of this report The following chapter coordinators were primarily responsible for the organization of chapter material:

I.	Planning for Urban Change	D Warner
II.	Transportation Technology	J W Bird
III.	Transportation and Modal Choice	J. C Ficht
IV	Transportation and Decision-Making in Tidewater	V J Stephens
V	Summary, Conclusions, and Policy Options	L F Darby

D. Additional Committees

During the second and third weeks a committee was formed to attempt to define the general direction to be taken by the design team

Task Outline Group

P H Wojciechowski, Chairman	D Warner
N H Erb	P R. Wozniak

During the last four weeks of the project, the following committees were established:

Editorial Committee

M Z Sincoff	C M Brooks
J S Dajani	

Illustration and Oral Presentation Committee

J W Bird, Chairman	A Van Gelder
L F Darby	P H Wojciechowski
L G Keeter	P R Wozniak
T W Mason	

In the last two weeks the following committee was established

Alice-in-Wonderland Committee

J C Ficht, J W. Bird, Chairmen
L. R. Darby

APPENDIX E

THE USE OF MODELS IN TRANSPORTATION

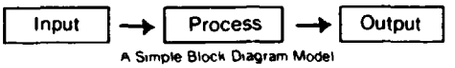
Modeling Theory

The systems approach to planning and problem-solving has been highly acclaimed, and modeling is an inherent part of this approach. Webster defined a system as "a set or arrangement of things so related as to form a whole ..." In further defining this word, he implied that these "things" are interrelated and interact in some manner. Thus in modeling, one must first determine the components of a process and then determine in what ways these components are interrelated and interact.

This concept is very simple and fundamental to logical thinking; it is used when a complex problem can be decomposed into several simpler ones, the simpler problems analyzed, and then an overall solution obtained by interconnecting the individual solutions. The difficulty with this method, however, is that it requires a high level of patience and discipline. The first questions to be asked are, "What is the problem, what are the goals and objectives, what does one want to know, and where does he want to go?" In many cases the main problem is that the answers to these questions are not known. The **only** thing that might be known is that there is a problem For instance, one might know that the system is not operating in the desired manner but might not know how the system **should** operate. In the systems approach, modeling is used to gain an insight into many of these questions.

Deutsch has indicated that a model serves at least four separate functions: **organizing, heuristic, predicting,** and **measuring.** A model **organizes** when it orders, arranges, and relates apparently disjointed or disparate facts. It is **heuristic** when it leads to new perceptions and new insights. When independent variables are manipulated or controlled, models can be **predictive,** yielding outcomes that can be quantified and **measured** (1).

Modeling as applied to system theory assumes a cause-effect relationship for the components of the system. Two popular modeling methods are mathematical modeling and block diagram modeling Mathematical modeling is a well-known and highly formalized system usually requiring mathematics beyond algebra and trigonometry (2, p 21). Block diagram models consist of blocks showing the various processes and their interrelationship. The inputs to these blocks are considered the controlling variable while the output is considered the controlled variable. In most simple block diagram models, the name of the process is simply inserted in the block.



A Simple Block Diagram Model

In models providing more information, the equations relating the output to the input are placed in the block In effect, when this is done, use is made of both the mathematical and block diagram modeling concepts The equations give the relationship between the input and the output and is called the transfer function. In formal modeling, the main concern is to find the transfer functions of the various blocks Thus, the system is completely characterized in that the "natural" tendency of the system to respond to inputs is found. Once this is done, the response of the system to any input can readily be predicted This aid in controlling systems and to predicting the reaction when certain events occur makes modeling a very valuable potential tool for planning.

Modeling has been widely used in transportation for many years. Traditionally, modeling in transportation had been centered around only two sub-systems of transportation; namely, that of predicting future transportation needs and that of traffic flow. These areas are highly specialized and, in most cases, those working in one area have had little communication with those in the other area. An investigation will show that those concerned with predicting future transportation needs (and associated areas) have been chiefly economists and civil engineers and that typical transportation studies have been concerned mainly with predicting future needs.

Much interest has been developed in traffic flow modeling in recent years. Sophisticated mathematical models for network flow (traffic volume flow) have been developed with impetus coming from those in such fields as electrical engineering, physics psychology, operations research, and mathematics.

Models for Predicting Future Transportation Needs.

As a basis for making predictions, these models have traditionally utilized three main variables; i.e., land use, population, and economic activity. Using such information, mathematical models have been designed for trip generation, trip distribution, modal split, traffic assignment, and land use. Trip generation is concerned with the number of trips that originate or terminate within each zone. Usually, trips will be stratified according to purpose. Trip distribution is concerned with the zone to which a trip will be made Origin-destination data are used in making this determination. Modal split is concerned with splitting the trips between various modes of transportation whereas traffic assignment is concerned with assigning trips to different routes available to each mode. For study purposes, a typical classification of land use might be residential, industrial, commercial, public and semi-public, water area, vacant, and miscellaneous Some of the well-known models are as follows (4, pp. 275-360):

a Trip Generation Models
   1 Land Area Trip Rate Analysis
   2 Cross Classification Analysis
   3 Regression Analysis

b Trip Distribution Models
   1 Growth Factor Methods
   2. The Gravity Model
   3 The Intervening Opportunity
   4. The Competing Opportunity

c. Modal Split Methods
   1 Trip End
   2 Trip Interchange

d Traffic Assignment Models
   1 All-or-Nothing Assignments
   2 Diversion
   3 Capacity Restraints
   4 Traffic Research Corporation Method

e. Land Use Models
   1 Multiple Regression
   2. Accessibility
   3 Schneider Opportunity
   4 Density Saturation Gradient

Traffic Flow Models

Two basic approaches to traffic flow modeling are in current use (3, p 346-358)

(1) The macroscopic or continuum model treats the flow of highway traffic in a manner similar to that of fluid

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flow. The flow of vehicles is considered to be continuous, and partial differential equations (instead of ordinary differential equations) are used to describe its dynamics. Derivatives are given in terms of time and separation distance.

(2) The microscopic or car-following model treats each vehicle and its driver on an individual basis. The driver is considered to be following a string of vehicles in front of him and the model takes into account the reaction time of the driver to outside stimuli. The dynamics are described by ordinary differential equations which may be linear or non-linear according to the assumptions made

References

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3. Leondes, C.T., Editor. *Control and Dynamics Systems Advances in Theory and Applications*, Vol. 10. New York: Academic Press, 1973.
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APPENDIX F

WASTED ENERGY AND THE EPA FEDERAL DRIVING CYCLE

Consider a very simple cycle consisting of a constant acceleration to cruise velocity, a constant speed cruise, followed in turn by a constant deceleration to stop. The mechanical energies associated with the three modes shall be labeled E_a, E_c, and E_d respectively. For convenience, change in vehicle elevation will not be considered (no hills). The sum of the energies associated with acceleration and cruise is

$$W_m = E_a + E_c,$$

which denotes the mechanical energy that must be supplied to the vehicle by its powerplant via the transmission. The energy of deceleration E_d, on the other hand, is normally wasted in the brake linings. Now let us characterize the driving cycle by a parameter χ defined by

$$\chi = E_d/W_m. \qquad (1)$$

Consequently χ ranges from a value of zero to unity, and represents that fraction of the total mechanical energy applied to the wheels which is theoretically capable of being recovered upon stopping and stored for reuse.

To obtain estimates of the above quantities, we must write the vehicle equation of motion and choose some representative values for vehicle parameters. The general equation of motion is

$$\frac{W}{g}\frac{dV}{dt} = F - R - D - W\sin\alpha, \qquad (2)$$

where F is the applied propulsive force at the wheels, R the rolling resistance, D the aerodynamic drag, and α the angle of grade in radians (which are taken to be zero here). The symbols W and g denote the vehicle weight and acceleration of gravity respectively, while R and D are defined by

$$R = 0.012\ W,$$

$$D = C_D\ Sq \quad , \quad q = \tfrac{1}{2}\rho v^2,$$

where the numeric 0.012, defining the fraction of weight contributing to rolling resistance, is a commonly used "handbook" value. The definition of aerodynamic drag is standard nomenclature. C_D, q, and S are the drag coefficient, dynamic pressure, and vehicle frontal area respectively.

The mechanical power required by the vehicle is obtained by solving equation (2) for F and multiplying by velocity,

$$P = FV\ \frac{\text{ft-lbs}}{\text{sec.}} = \frac{FV}{550}\ \text{hp}, \qquad (3)$$

and the mechanical energy is just the time integral of power

$$E = \int_{t_1}^{t_2} P(t)dt\ \ \text{ft-lbs} = \frac{1}{550}\int_{t_1}^{t_2} P(t)dt\ \ \text{hp-sec.} \qquad (4)$$

Now for the simple driving cycle described above, consisting of a constant acceleration followed by a constant speed cruise and terminated with a constant deceleration, explicit expressions can be obtained for the energies of all three modes.

$$E_a = \frac{W V_c^2}{2g}\left[1 + \frac{1}{a/g}\left(.012 + \frac{C_D q_c S}{2W}\right)\right]$$

$$E_c = .012 W D_c\left[1 + 167\,\frac{C_D q_c S}{2W}\right] \qquad (5)$$

$$E_d = \frac{W V_c^2}{2g}\left[1 - \frac{1}{d/g}\left(.012 + \frac{C_D q_c S}{2W}\right)\right]$$

where a/g and d/g represent the vehicle acceleration and deceleration as fractions of the acceleration of gravity.

For vehicle parameters, assume that

W = vehicle weight = 4000 lbs.

S = frontal area = 25 ft^2

C_D = drag coefficient = .40

and to examine a specific driving cycle, take

a = vehicle acceleration = 5 ft/sec^2

V_c = cruise velocity = 44 ft/sec

d = vehicle deceleration = 6 ft/sec^2

D_c = cruise distance = 1930 ft

These numbers correspond to the cycle illustrated in Figure F-1 which is 60 seconds long from start to stop and covers a total distance of 2.285 ft. Also shown in Figure F-2 are the force and power curves for the cycle.

From the formulas for energy and the numerical values specified above, note that

E_a = 245 hp-sec

E_c = 250 hp-sec

E_d = 201 hp-sec

Consequently the total work done on the vehicle is

$$W_m = E_a + E_c = 495\ \text{hp-sec},$$

and the maximum reclaimable energy is 201 hp-sec. The parameter defined by equation 1 is then

$$\chi = E_d/W_m = 0.41,$$

which implies that a little over 4/10 of the mechanical work supplied to the vehicle would be wasted as heat in the brakes for this example. Admittedly this is a contrived result based upon an over-simplified model, but what is somewhat surprising is that almost the same result is obtained for a much more realistic example, namely the EPA driving cycle used for emissions evaluation.

The basic EPA Federal Driving Cycle (FDC) shown in Figure F-3 consists of 17 start-stop driving cycles of 18 to 189 seconds duration, interspersed with idling times of from

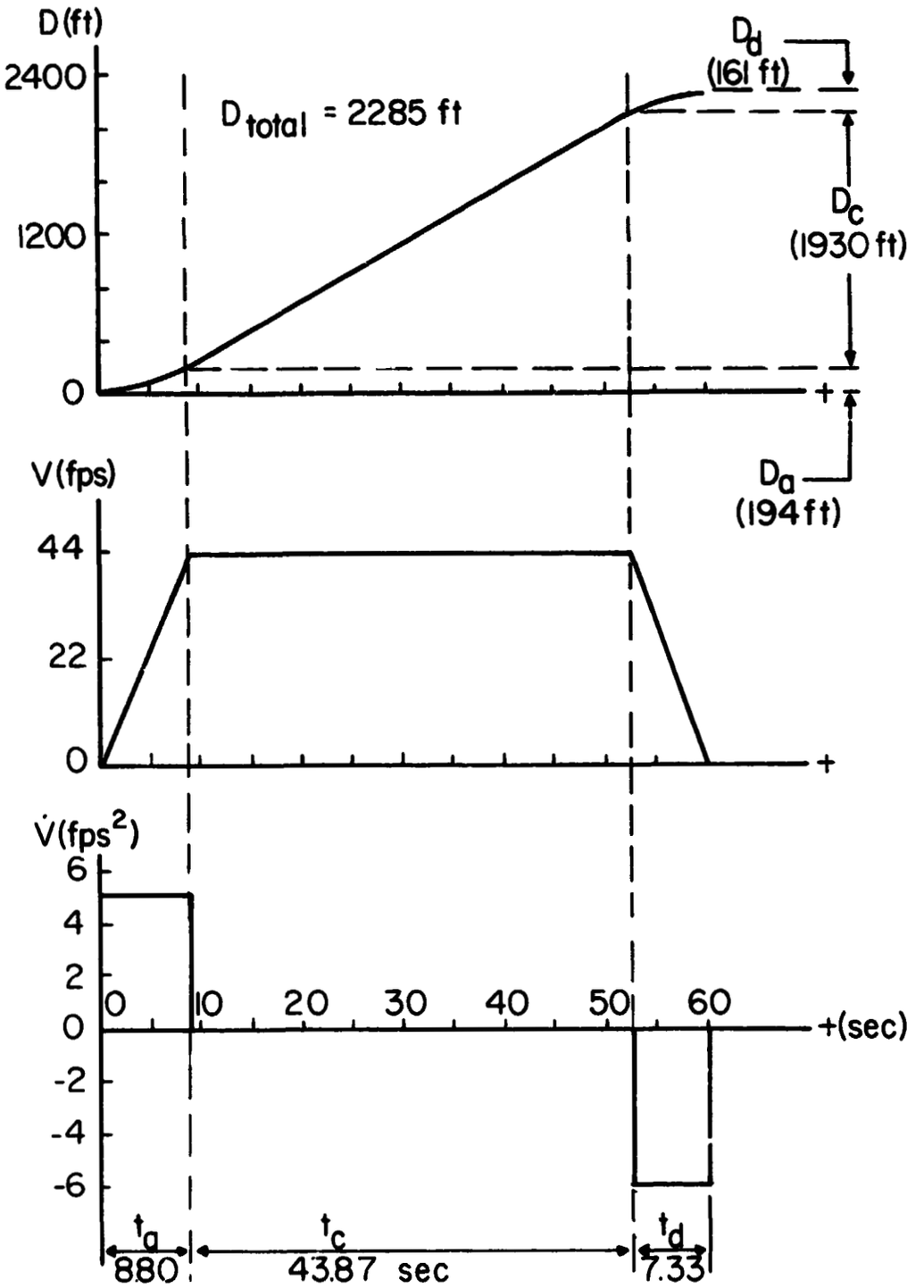

FIGURE F-1
ONE MINUTE CYCLE KINEMATICS

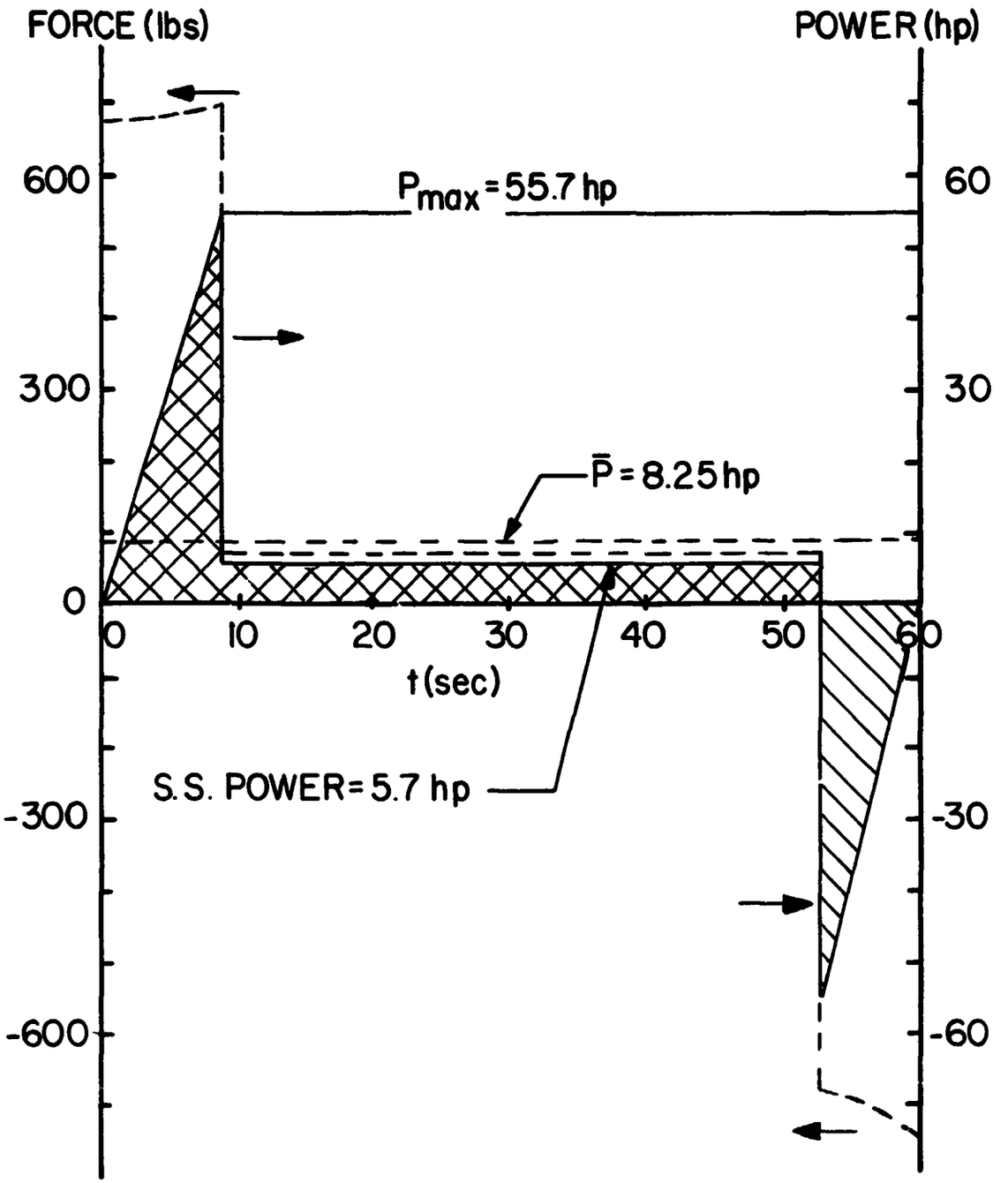

FIGURE F-2
FORCE & POWER REQUIREMENTS
OF ONE MINUTE CYCLE

3 to 38 seconds The entire schedlue time is 22.9 minutes during which the automobile covers 7.5 miles. With the vehicle parameters previously used, the schedule was analyzed to trace the utilization of energy. [1] Since Periods of constant acceleration or constant cruise velocity (as in the simple model) are unrealistic to identify, only the total mechanical work W_m delivered to the vehicle and the theoretically recoverable energy W_d were calculated. In Table F-1, the results are summarized for each cycle along with totals for the entire schedule.

Consider the first cycle, 150 seconds in duration. Of the 714 hp-sec of work delivered to the vehicle, 319 hp-sec are potentially available for storage upon deceleration, yielding a value of X equal to 0.431. In other words, about 43 percent of the expended energy is available for reclaimation. For the entire schedule, X equals 0.381 which means that about 38 percent of the expended energy is being wasted in the brake linings—or alternatively, is potentially available for reuse.

Observe that the two long cycles, numbers 2 and 10, have the lowest values of X and hence represent the main source of energy dissipation in the schedule. Together, cycles 2 and 10 account for almost half the distance traveled (3.5 miles). Without these two cycles, a total W_m of 5,118 hp-sec would be supplied to the vehicle with 2,675 hp-sec ideally recoverable, which results in a value of X equal to 0 523 for a four-mile trip The significance of this figure can be appreciated by observing that the resulting schedule, consisting of many short start-stop cycles, is not unlike that of a city bus, suggesting the possibility of the need for immediate research and development of the hybrid bus alluded to in Chapter II.

[1] Dunn, H.S. and P H Wojciechowski "High-Pressure Hydraulic Hybrid with Regenerative Braking," Proceedings of the 7th IECEC, San Diego, California, Sept. 1972, pp. 989-995.

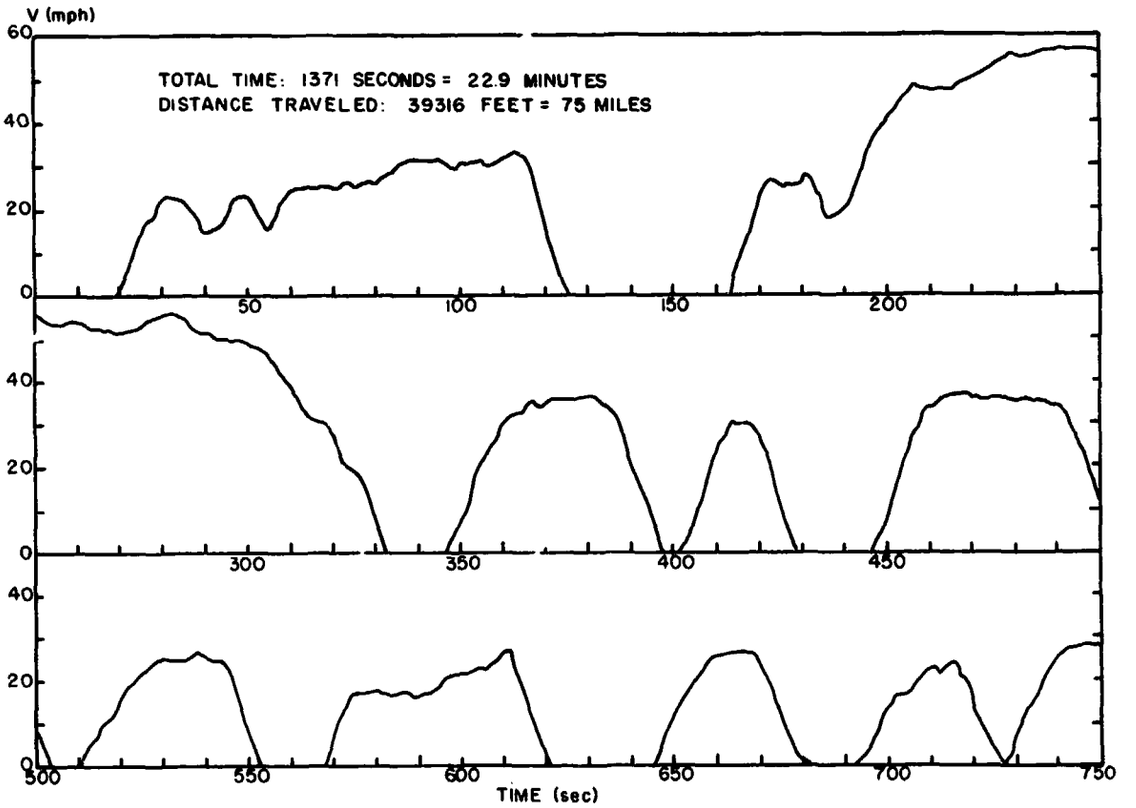

Figure F-3 EPA DRIVING SCHEDULE

FIGURE F-3
EPA DRIVING SCHEDULE

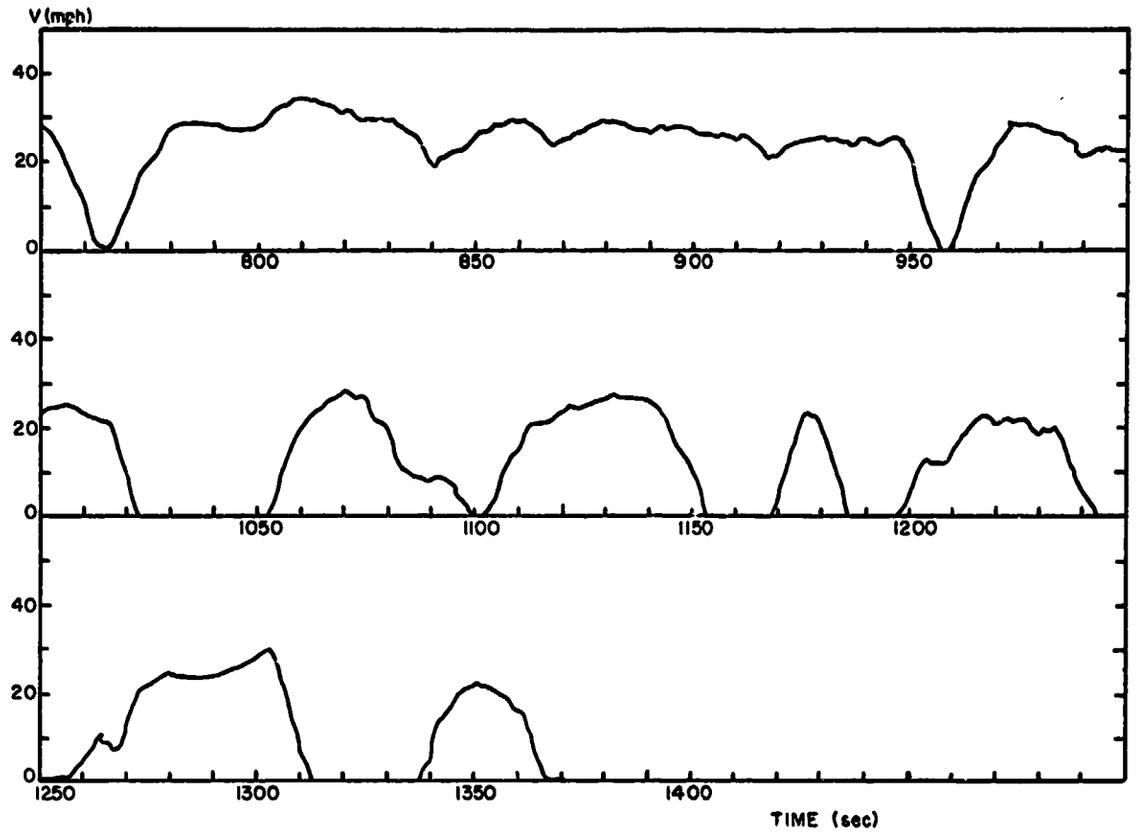

TABLE F-I

ENERGY ANALYSIS OF EPA DRIVING SCHEDULE

Cycle	t sec	t_D sec	D ft	Vmax ft/sec	W_m hp-sec	E_d hp-sec	E_L hp-sec	P_D hp	X E_d/W_m
1	150	104	3555	47.5	741	319	422	7 12	.431
2	190	169	10352	83 2	2518	490	2028	14 90	195
3	60	50	1944	53.6	518	258	260	10 36	497
4	40	26	745	44 2	266	179	87	10.23	634
5	66	57	2367	53 1	565	240	325	9 91	.425
6	54	41	1105	38 1	253	131	122	6 17	517
7	70	51	1333	39 6	295	154	141	5 78	522
8	52	34	890	38 9	238	140	98	7 00	586
9	83	72	1707	42 0	450	262	188	6.25	.583
10	193	190	7153	50 3	1149	278	871	6 05	.242
11	72	63	1981	41 8	373	148	225	5 92	396
12	70	47	1099	41 5	257	136	121	5.47	.531
13	60	51	1469	39 6	299	133	166	5 86	446
14	30	18	360	34 5	151	114	37	8 39	752
15	60	47	1046	32.3	200	92	108	4 26	.460
16	70	61	1546	42.7	360	186	174	5.90	518
17	51	29	660	32 9	153	85	68	5 28	.553
Total	1371	1110	39316		8785	3343	5442		381

t - duration of complete cycle
D - distance traveled in cycle
W_m - mechanical work done on vehicle
E_L - energy lost to friction
t_D - driving time of cycle
Vmax - maximum cycle velocity
E_d - reclaimable energy
P_D - average power required

APPENDIX G

Tidewater Transportation Survey Background

This questionnaire was sponsored by the Virginia Metropolitan Areas Transportation Study Commission. The questionnaire was developed by Mr. D. William Conner and Mr. Bobby G. Batten at NASA and was distributed by the Virginia Metropolitan Areas Transportation Study Commission with the cooperation of the Tidewater Jaycees. An estimated ten thousand surveys were personally delivered to respondents by the Jaycees. Of this number, approximately 1,700 were returned.

Returned questionnaires were scored by the staff of the computer center at the University of Virginia under the direction of Dr. Ira Jacobsen The results were evaluated as part of the NASA-ASEE System Design Team Project.

A. BACKGROUND INFORMATION

To date a total of 1,667 questionnaires have been returned, scored, and run through the computer. This sample of questionnaires can be described according to the following demographic factors:

1. Age
2. Sex
3. Income
4. Marital status
5. Occupation
6. Education
7. Automobile license
8. Own auto
9. Day or night work schedule

1. Age:

The mean average age for this sample is 41.2 years with a median age of 39.73 (std. - 10.5 yrs). Age distribution is as follows:

TABLE G-I

Age Distribution in Percentages

1-10	**.1**
11-20	**8.1**
21-30	**33.2**
31-40	**23.7**
41-50	**18.0**
51-60	**11.6**
61-70	**4.0**
71-80	**1.2**
81-	**.1**

2. Sex:

More males than females completed VMASC questionnaire with 1,052 males returning the forms as compared with 597 females while 17 respondents were undecided!!

3. Income:

Table G-II presents percentage breakdown of respondents in different income levels. The $10,000-$19,000 income bracket contains the most frequently chosen income range

TABLE G-II

Income Distribution in Percentages

Under 10,000	25.2
10,000-19,000	36.7
20,000-29,000	17.7
30,000-39,000	6.8
40,000-	7.1
Blank	6.4

4. Marital Status:

Seventy-one percent of the population were married as opposed to twenty percent who were single. Six percent were supporting dependents (seperated, divorced, or widowed) while 1.6 percent chose to leave this question unanswered.

5. Primary Occupation:

The sample drawn by the Jaycees appears to be a composition of two major occupational levels, professional and managerial, with these two groups representing over 60 percent of the respondents. Considering the group membership of the Jaycees, these demographic characteristics of the sample population are not surprising. Table G-III presents a further breakdown of the sample into different occupational backgrounds.

TABLE G-III

Occupational Breakdown in Percentages

Homemaker	7.7
Student	8.6
Sales	4.4
Craftsman	5.2
Secretary, Clerical	7.6
Professional	25.0
Farming, Fishing, Forestry, etc	.2
Manager, Office Executive	23.8
Other	17.5

6. Education:

Almost fifty-nine percent of the sample had at least some college education and over 13.6 percent had advantaced college degrees. This is slightly above the national average.

7. Miscellaneous Characteristics:

Ninety percent of the population responded "yes" to "Do you have an automobile driver's license," while 84 percent said they owned a car. Almost 15 percent of the sample did not own a car. Only 3.7 percent of the sample indicated that they worked at night.

B QUESTIONNAIRE

1. Attitudes on City Living

Question 1 measures attitudes towards city living using a 7-point Likert-type scale ranging from "agree very much" to "disagree very much." The questionnaire lists six characteristics associated with city living which are as follows:

traffic
good shopping
pollution

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TABLE G-IV

CHARACTERISTICS OF CITY LIVING							
	Agree Very Much	Agree Much	Agree Some	No Opinion	Disagree Some	Disagree Much	Disagree Very Much
I **dislike** city (urban) living because of traffic	21.1	16.6	29.9	9.2	12.0	5.0	5.8
I **like** city (urban) living because of the good shopping	21 5	23.8	30.7	7.6	9.1	4.5	2.8
I **dislike** city (urban) living because of pollution	24 3	17.1	26.6	14.0	10.2	4 1	3.7
I **like** city (urban) living because of the entertainment, social, and cultural opportunities	31 7	23.8	25.4	9.4	4.8	2.1	2.8
I **dislike** city (urban) living because of noise	19 9	15.6	28 2	14 4	12.3	4.4	5.1
I **dislike** city (urban) living because it is not a safe environment	20 7	13.2	28 5	11.8	15.6	5.2	5.1
Percentage of Respondents in Different Attitude Categories							

entertainment, social and cultural opportunities
noise
not a safe environment

The respondents were asked to agree or disagree with statements regarding each of the above characteristics

Table G-IV presents a summary of responses in percentages to each of the six questions

Results seem to indicate that respondents had no strong agreements or disagreements toward statements made in question one The most frequently occurring response (mode) for all subquestions was "agree some "

Relatively stronger responses were found for two city characteristics The sample population indicated some concensus on pollution as a nonattractant in city living while agreeing with the statement that city living offers the advantages of entertainment and culture

2. Choice of Living Environment

Question No 3 explores urban versus suburban living preferences It is assumed that, given an adequate mass transportation system, individuals would prefer to live in more remote areas if they were still able to enjoy the advantages of city living About sixty percent (62 5%) responded 'yes' to this question, while twenty-four percent responded 'no

TABLE G-V

3 If you could be p' . Jed with a highly desirable public transportation sys' 1 of future design that would meet your requirements, would you like to live in an environment removed from the city?

Yes	62.5%
No	24.2%
No opinion	13.3%

3. Transportation System Characteristics

Table G-VI presents the mean ranks and standard deviations for each of the transportation system characteristics

TABLE G-VI

Characteristics	Rank $\bar{X}$	Std.	order
Easily accessible	2 6	1 8	1
Fast	3 9	1 9	3
Cheap	4 5	2.05	5
Modern/attractive/cheap	4 7	1 9	6
Operated with frequent service	3 8	1.9	3
connected to large number of points within my region	4 7	2 0	7
Dependabili',	3 5	2 0	2

4. "Accessibility" Defined

The results found in Table G-VI indicate that transportation system characteristics were relatively non-discriminating items in terms of the sample population's choices. It is interesting to note that accessibility was ranked higher than cheapness. A similar statement can also be made for dependability, indicating that the potential consumer values accessibility and dependability over cost factors.

Although the results found in Table G-VI indicate that transportation system characteristics were relatively nondiscriminating items in terms of the sample population's choices, it is interesting to note that accessibility was ranked higher than economy. A similar statement can also be made for dependability, indicating that the potential consumer values accessibility and dependability over cost factors.

Table G-VI indicated that accessibility was ranked by the sample population as the most important characteristic of mass transportation. Question number five asked the respondent to indicate his definition of "accessibility". Table G-VII presents a summary of responses to this question.

TABLE G-VII

Percentage of Responses to Question on Accessibility

I mean one of the following as the **maximum acceptable** when I describe public transportation as easily accessible

4 miles from home (auto parking available) and 3 blocks from work	13.7%
3 miles from home (auto parking available) and 3 blocks from work	6.3%
2 miles from home (auto parking available) and 3 blocks from work	28.2%
No opinion	15.8%
None of the above—I mean ___ miles from home and ___ blocks from work	35.8%

Twenty-eight percent defined "accessibility" as public transportation which is two miles from home and three blocks from work, while thirty-five percent held opinions which were not included on this questionnaire. A random sample of this thirty percent indicated a definition of less than two miles from home and three blocks from work.

5. "Fast" Defined

Speed was also perceived by the sample population as a relatively important characteristic of an effective public transportation system.

Transportation was described as fast most frequently as twenty minutes to work and twenty minutes to major entertainment, shopping, and social facilities. Table G-VIII presents a percentage breakdown of responses to each category.

TABLE G-VIII

Percentage of Response to Question 6

6 When I describe transportation as **fast,** I mean one of the following as **acceptable**

30-45 minutes to work	5.4%
30-45 minutes to work and 30-45 minutes to major entertainment, shopping and social facilities	6.2%
30 minutes to work	5.0%
30 minutes to work and 30 minutes to major entertainment, shopping, and social facilities	13.1%
25 minutes to work	3.7%
25 minutes to work and 25 minutes to major entertainment, shopping, and social facilities	9.9%
20 minutes to work	6.9%
20 minutes to work and 20 minutes to major entertainment, shopping, and social facilities	21.5%
15 minutes to work	6.2%
15 minutes to work and 15 minutes to major entertainment, shopping, and social facilities	17.4%
None of the above—I mean	4.7%

6. "Cheap" Defined

While economy was not ranked as a relatively important system characteristic, there was a general consensus on the part of over half the respondents on agreeing that a "cheap" system should charge less than the operating costs of a private vehicle. Only twenty-six percent of the sample population who responded to this question felt that public transportation should be as expensive or more expensive than the out-of-pocket automobile cost. Table G-IX gives responses in percentages to Question 7.

TABLE G-IX

7 When I describe public transportation as **cheap** within my living and working region, I mean one of the following

Cost slightly more than out-of-pocket expense for the operation of private auto	5.8%
Cost equal to out-of-pocket expense for the operation of private auto	12.9%
Cost equal to out-of-pocket expense for the operation of private auto plus parking expense	9.4%
Cost less than out-of-pocket expense for the operation of private auto	40.5%
Cost greatly less than out-of-pocket expense for the operation of private auto	24.5%
No opinion	6.9%

A random sample of questionnaires indicates that the model estimate of cost is approximately $1.50 per day (as indicated in question 8). Consequently, one can assume that the potential consumer of mass transportation is looking for a system which will fall below this cost level on a daily basis.

7. Other Transportation Characteristics Refined

Table G-X presents percentages of responses to questions 9, 10, and 11. Results indicated little general agreement on what constitutes frequent service. Twenty-six percent chose a 30-minute delay between buses as sufficiently frequent, while twenty-seven percent would be satisfied with no more than a 15-minute wait between scheduled service.

Regular service was defined by fifty-five percent of the sample population as meaning regular service between the hours of 6 a.m. and 8 p.m. with less frequent runs through the remainder of the night. Thirty-four percent of the sample desired service beyond the hour of midnight.

The need for inter-modal mass transportation was perceived by almost seventy-five percent of the sample population. Sixty-three percent agreed strongly to the need for connections between city buses and airports or intercity train stations. Only seven percent disagreed.

TABLE G-X

9. When I say frequent service, I mean one of the following as the maximum time acceptable:

30 minutes between scheduled service	29.1%
25 minutes between scheduled service	3.7%
20 minutes between scheduled service	32.1%
15 minutes between scheduled service	28.6%
None of the above—I mean	6.5%

10 To be of real value to me, the public transportation must be in regular service:

7:00 a.m to 7:00 p m	21.8%
6:00 a.m. to 8:00 p.m.	10.2%
6:00 a.m to 8:00 p.m., with less runs between 8:00 p m. and 12:00 midnight	21.5%
6:00 a.m. to 8 00 p m , with less runs between 8 00 p.m. and midnight plus some runs between midnight and 6:00 a.m.	36.7%
No opinion	5.3%
None of the above	4.4%

11. The type transportation suggested would also have to connect directly with: major and regional airports, and intercity train and bus stations

Agree very much	46 1%
Agree much	14.3%
Agree some	20.2%
No opinion	12.4%
Disagree some	3 5%
Disagree much	1 2%
Disagree very much	2.2%

8. Public Transportation Use in Future

Fifty-eight percent responded to question twelve affirmatively regarding public transportation use. Twelve percent of the sample indicated little perceived use of future public transportation systems.

TABLE G-XI

Future Mass Transportation Uses

12. If a public transportation system of the future was provided that met my requirements, I would leave my car in my immediate home area.

Nearly all the time	22.0%
Most of the time	23.9%
Much of the time	19.3%
Some of the time	18.5%
No opinion	4.8%
Very little of the time	6.9%
Never	4.6%

9. Current Use Statistics

Table G-XII presents the percentage of the sample which currently uses public transportation. Six percent of the sample currently uses public transportation to work while 80 percent uses the private auto.

TABLE G-XII

14 Do you currently use a private auto or public transportation as your transportation to work?

Private auto	80.5%
Public Transportation	5.8%
Blank	13.7%

APPENDIX H

REPORT ON STATUS OF URBAN MASS TRANSPORTATION LEGISLATION IN 1974

The Urban Mass Transportation Act of 1964 does not provide for federal grants of operating funds. As failure to generate operating funds sufficient to cover expenses has been the primary cause of private bus company failures, there has been much discussion of amending the 1964 act to combat the problem.

Mr. Robert R. Nathan, president of Robert R. Nathan Associates (an economics consulting firm) ably presented the operating cost dilemma to a subcommittee of the House Committee on the District of Columbia in his statement of May 23, 1967.[1] He explained that nationally the number of passengers carried per mass transit employee has varied only from 46,000 to 48,000 per year from 1954 to 1965; "In other words, if we measure productivity per employee in the mass transit industry by using the figure of revenue passengers per employee, we find it is practically level over the past 11 years."[2] Further, he stated that labor expenses were approximately 86 percent of all operating costs of the D.C. Transit System; "So, with labor costs constituting 86 percent of the operating expenses and with wage rates turning upwards persistently, the logical and inevitable conclusion is that the unit cost for transit operation increases."[3]

After previously unsuccessful attempts, a bill (S.386, The Emergency Urban Mass Transportation Assistance Act of 1974) providing for operating assistance was passed by both houses of Congress and reported out of conference February 26, 1974.[4] However, this legislation was delayed indefinitely in the House Rules Committee March 6, under threat of Presidential veto.[5]

As an alternative to S.386, the Nixon Administration proposed legislation (S.3035; H. R. 12859) combining highway and transit assistance programs into the Unified Transportation Assistance Program—"UTAP." Department of Transportation Secretary Claude S. Brinegar acknowledged to the Senate Public Works Transportation Subcommittee on March 12, 1974 that the proposal "was a significant policy change," in that it would contain funds for operating assistance.[6]

On Tuesday, July 30, 1974, the House probably acted to effectively kill S. 386 by voting 221-181 to send the bill back to House-Senate conference. The Administration's legislation appeared on the House floor the week of August 12th. S. 386 would have appropriated $800 million over an 11 month period, while the UTAP bill as reported by the Public Works Committee would expend $20 billion over 6 years. Reasons expressed for the unexpected referral of S. 386 to conference were the formation of a coalition of "rural and conservative representatives" who labeled the bill a "big-city boondoggle."[7] Rep. Del Clawson (R.—Calif.) pointed out in floor debate that the bill would have given New York City and northern New Jersey more money than the combined amounts for Los Angeles, Chicago, Philadelphia, Detroit, San Francisco, Boston, and Washington, saying "It is not a big-city bill, it is a single-city bill."[8]

The single-city thrust of S.386 raises an important national policy question: Should federal operating cost assistance be aimed at urban transportation users having the greatest need, regardless of whether such an approach happens to directly convey much more money to one urban area than others (the result of enacting S. 386), or should the distribution of federal transit money be more closely tied to population (the general result of UTAP)? It should be noted that while S. 386 would have provided significantly more money for the New York City Area than any other, New York City "alone has about 40 percent of the nation's subway and bus riders."[9]

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[1] *Hearing on H.R. 7602 Before Subcomm. No. 3 of the House Comm. on the District of Columbia*, 90th Cong., 1st Sess. (1967)

[2] *Id.* at 17

[3] *Id.* at 19

[4] 32 *Cong. Q.* 685 (1974)

[5] *Id.*

[6] *Id.*

[7] N.Y. *Times*, July 31, 1974, at 1

[8] *Id.*

[9] *Id.*

APPENDIX I

STATUTORY POWERS OF VIRGINIA'S REGIONAL AGENCIES HAVING RESPONSIBILITY FOR TRANSPORTATION

The most important statutory powers of Virginia's regional agencies are set out below. The agencies also have powers incidental to carrying out their legislative mandates. (All references are to the Virginia Code Annotated, 1973 Replacement Volume.)

Planning District Commission

1. To perform the Planning envisioned by the Virginia Area Development Act (§15.1-1404(a)).

2. To make and enter into contracts, and to obtain grants from both the federal and state governments (§§15.1-1404(b) (4)-(5)).

Transportation District Commissions

For transportation districts located within a metropolitan area **wholly within** Virginia:

1. To "construct or acquire, by purchase or lease, the transit facilities specified in (their) transportation plan(s)" (once those plans have been drawn). (Va. Code Ann §15.1-1357(a) (2)).

2. May contract with private companies and the counties and cities within the district for the operation of transit facilities, but may operate such themselves unless private operation is impractical. (§§15.1-1357(a) (3)-(4)).

3. "To exercise exclusive control. . .of matters of regulation of fares, schedules, franchising agreements and routing of transit facilities within the boundaries of (the) transportation districts(s)...."

For transportation districts located within a metropolitan area **not wholly within** Virginia:

1. Such transportation districts are prohibitted from preparing a transportation plan and constructing or operating transit facilities; they are, instead, required to cooperate with the metropolitan area's transportation agency and with the political units within that agency's jurisdiction. (§§15.1-1357(b) (1)-(2)).

2. May acquire land or use thereof for parking facilities or other use in connection with transportation service and mass transit plan, respectively. (§§15 1-1357(b) (i)-(ii)).

3 May obtain transit service by contract with any private or public entity (§§15 1-1357(b) (iii)).

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